PROVINCIAL HEALTH OFFICER'S DRINKING WATER REPORT

Clean, Safe, and Reliable Drinking Water

BRITISH COLUMBIA
Office of the Provincial Health Officer

An Update on Drinking Water Protection in BC
2017/18–2021/22

Front cover captions:

(Left) View from a ferry on the Fraser River of the Lytton Creek wildfire burning through the Village of Lytton in 2021.

Photo credit: Warren Brown, CWP CWWP, Operations & Maintenance Manager, Lytton First Nation. Environmental Operators Certification Program Operator Digest – Winter 2022/Number 151.Reproduced with permission.

(Middle) The Sunshine Coast Regional District uses siphons to access emergency drinking water storage when water in Chapman Lake no longer flows naturally into Chapman Creek.

Photo credit: Sunshine Coast Regional District.

(Right, back cover) Flooding in Sumas Prairie, Abbotsford during the 2021 atmospheric river.

Photo credit: City of Abbotsford.

Electronic copies for this report (in a .pdf file) are available at:

www.health.gov.bc.ca/pho/reports/drinkingwater

Ministry of Water, Land and Resource Stewardship
Victoria, BC
lək̓ʷəŋən Territory

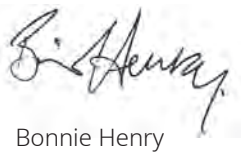
February 2024

The Honourable Nathan Cullen
Minister of Water, Land and Resource Stewardship

Dear Minister:

I have the honour of submitting the Provincial Health Officer's report, *Clean, Safe, and Reliable Drinking Water: An Update on Drinking Water Protection in BC*, 2017/18 to 2021/22.

Sincerely,



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OBC, MD, MPH, FRCPC
Provincial Health Officer

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Acronyms and Initialisms

AEM Code	Code of Practice for Agricultural Environmental Management
AO	Aesthetic objectives
BCCDC	BC Centre for Disease Control
BCCDC PHL	BC Centre for Disease Control Public Health Laboratory
BCER	BC Energy Regulator
BCWWA	BC Water and Waste Association
BWN	Boil water notice
CBWM	Community-based water monitors
CRD	Capital Regional District
CRM	Customer Relationship Manager
CWP	Certified Water Professional
CWWP	Certified Wastewater Professional
DNC	Do not consume
DNU	Do not use
DWIS	Drinking Water Information System
DWO	Drinking water officer
DWPA	*Drinking Water Protection Act*
DWPP	Drinking water protection plans
DWPR	Drinking Water Protection Regulation
EHO	Environmental health officer
EMA	*Environmental Management Act*
EMBC	Emergency Management BC
EMCR	Ministry of Emergency Management and Climate Readiness
ENV	Ministry of Environment and Climate Change Strategy
EOCP	Environmental Operators Certification Program
EPHS	Environmental Public Health Services
ERCP	Emergency response and contingency plans
EWQA	Enhanced Water Quality Assurance
FLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
FNHA	First Nations Health Authority
FOR	Ministry of Forests
FTE	Full-time equivalent
GARP	Groundwater at risk of containing pathogens
GCDWQ	Guidelines for Canadian Drinking Water Quality
HLTH	Ministry of Health
ISC	Indigenous Services Canada

MAC	Maximum acceptable concentration
MUNI	Ministry of Municipal Affairs
NID	Nasookin Improvement District
NTU	Nephelometric turbidity unit
OAG	Office of the Auditor General
PHO	Provincial Health Officer
POUT	Point-of-use testing
qRD	qathet Regional District
SCRD	Sunshine Coast Regional District
SPHI	Strengthening Public Health Initiative
UV	Ultraviolet
VOCs	Volatile organic compounds
WLRS	Ministry of Water, Land, and Resource Stewardship
WQA	Water quality advisory
WSA	*Water Sustainability Act*
WSS	Watershed Security Strategy
WUC	Water Users' Community
WUCA	*Water Users' Community Act*

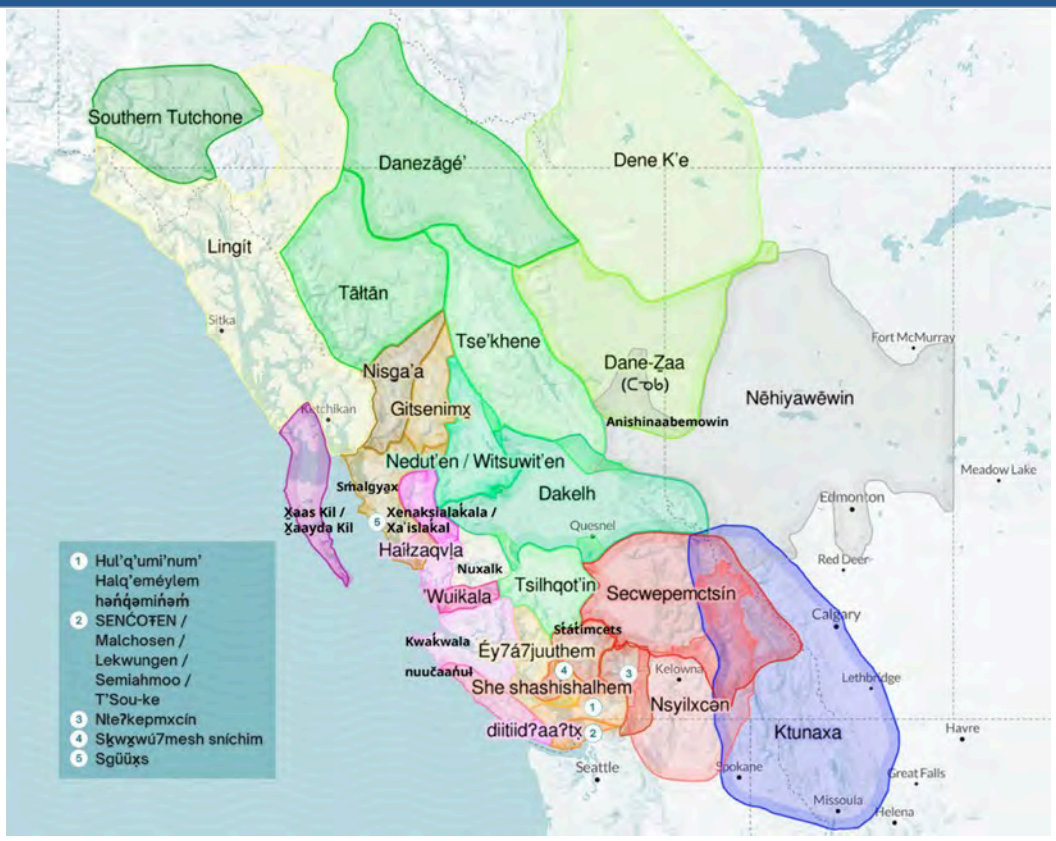
Acknowledgements

Land and Waters Acknowledgement

We acknowledge with great respect the territories of the lək̓ʷəŋən peoples on which the Office of the Provincial Health Officer stands, and the Songhees, Esquimalt, and W̱SÁNEĆ peoples whose historical relationships with the land continue to this day. We recognize and express our gratitude for the medicines within these territories, and the First Nations territories that stretch across every part of the province of British Columbia.

There are 34 First Nations language groups in BC, whose territories stretch across every part of the province as highlighted in *Figure A*. To learn more about the First Peoples' Map of BC, visit *https://maps.fpcc.ca/*.

Figure A: First Peoples' Map of BC



Source: © First Peoples' Cultural Council.

Inherent Indigenous Rights Acknowledgement

We acknowledge with respect the inherent rights of the First Nations whose ancestral territories cover all of the province now known as British Columbia, including their unextinguished land and water rights and rights to self-determination, health, and wellness within these territories. Laws and governance systems rooted in the lands and waters have upheld the sovereignty of these diverse Nations for thousands of years. The rights and responsibilities of First Nations to their ancestral territories have never been ceded or surrendered, and are upheld in provincial, national, and international law.

We also recognize that many Indigenous Peoples (First Nations, Métis, and Inuit) from elsewhere in what is now known as Canada and beyond also call these lands and waters home, and they too have inherent Indigenous rights to self-determination, health, and wellness. This includes Métis Nation British Columbia and its Chartered Communities across BC, as well as those whose ancestral territories are outside of BC.

We recognize that the BC *Declaration on the Rights of Indigenous Peoples Act*[1] and other legislation requires us to uphold the United Nations Declaration on the Rights of Indigenous Peoples,[2] meaning that we must change our processes to align with this declaration. We acknowledge that this report-writing process was not yet in alignment with these requirements, and that we continually strive to do better going forward.

Specific acknowledgments related to this report include:

- Recognizing that within many Indigenous perspectives, "The ecosystems of Mother Earth need to be recognized as foundational to the health of all beings because the ecosystem is our health system";[3]
- Recognizing that the colonial structure of BC provincial law was created and imposed over existing First Nations laws and governance systems that are tied to land and water, and that imposed laws are rooted in an understanding of Crown sovereignty, which is now called into question by the *United Nations Declaration on the Rights of Indigenous Peoples Act*[4] and the Vatican repudiation of the Doctrine of Discovery;[5]
- Recognizing that the *Drinking Water Protection Act* and the ways in which the Provincial Health Officer is mandated to report as per this legislation diminishes the conversation regarding First Nations and water to the imposed *Indian Act*'s "on-reserve" jurisdiction rather than Aboriginal rights and title upheld in the Canadian constitution and Canadian courts, and at this time, this report continues to uphold the legislative framework of *Indian Act* understandings of "First Nations territory" rather than Aboriginal rights and title upheld in our constitution and Canadian courts; and
- Recognizing that the BC *Declaration Act Action Plan*[6] acknowledges legal pluralism in BC, recognizing that within Canada there are multiple legal orders, including Indigenous laws and legal orders with distinct roles, responsibilities, and authorities. Future reports will seek to better uphold shared decision-making and First Nations legal systems within the province.

Foundational Obligations to Indigenous Rights in Relation to Water

We understand that we have been given Foundational Instructions from Indigenous Peoples related to inherent rights and water:

International –

United Nations Declaration on the Rights of Indigenous People:[2]

- Article 25 states: "Indigenous Peoples have the right to maintain and strengthen their distinctive spiritual relationship with their traditionally owned or otherwise occupied and used lands, territories, waters and coastal seas and other resources and to uphold their responsibilities to future generations in this regard."
- Article 26 states in part: "Indigenous Peoples have the right to the lands, territories and resources which they have traditionally owned, occupied or otherwise used or acquired" and "States shall give legal recognition and protection to these lands, territories and resources. Such recognition shall be conducted with due respect to the customs, traditions and land tenure systems of the Indigenous Peoples concerned."

- Article 32 states in part: "States shall consult and cooperate in good faith with the Indigenous Peoples concerned through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water or other resources."

National –

Truth and Reconciliation Commission of Canada: Calls to Action:[7]

- Call to Action 43 states: "We call upon federal, provincial, territorial, and municipal governments to fully adopt and implement the United Nations Declaration on the Rights of Indigenous Peoples as the framework for reconciliation."
- Call to Action 47 states: "We call upon federal, provincial, territorial, and municipal governments to repudiate concepts used to justify European sovereignty over Indigenous Peoples and lands, such as the Doctrine of Discovery and terra nullius, and to reform those laws, government policies, and litigation strategies that continue to rely on such concepts."

Reclaiming Power and Place: The Final Report of the National Inquiry into Missing and Murdered Aboriginal Women and Girls:[8]

- Call for Justice 4.1 states: "We call upon all governments to uphold the social and economic rights of Indigenous women, girls, and 2SLGBTQQIA[a] people by ensuring that Indigenous Peoples have services and infrastructure that meet their social and economic needs. All governments must immediately ensure that Indigenous Peoples have access to safe housing, clean drinking water, and adequate food."

BC Provincial –

BC Declaration Act Action Plan:[9]

- Action 2.7 calls for the Ministry of Water, Land and Resource Stewardship to: "Collaborate with First Nations to develop and implement strategies, plans, and initiatives for sustainable water management, and to identify policy or legislative reforms that support Indigenous water stewardship, including shared decision-making. Co-develop the Watershed Security Strategy with First Nations and initiate implementation of the Strategy at a local watershed scale."

First Nations Population Health and Wellness Agenda:[10]

- Under the description of the indicator of ecological wellness and connection to land, this report underscores the importance of acknowledging and monitoring ecological health from a First Nations perspective. This section includes reminders that:
  - "Land, water, and territory permeate all aspects of First Nations wellness, as they are sources of healing, and of mental, physical, spiritual, and emotional health and wellness."
  - "Many population health reports include a measure of environmental health, but they tend to be reductionist measures that focus on human risks from environmental hazards (e.g., water pollution, soil contamination) and environmental deficits (e.g., fishery declines, deforestation). Those measures are useful to monitor risks to human health resulting from human contaminants or development, but they do not reflect a First Nations perspective of the land.[b]"

[a] 2SLGBTQQIA: Two-spirit, lesbian, gay, bisexual, transgender, queer, questioning, intersex and asexual. Terminology and acronyms continue to evolve. A glossary of common acronyms used by the Government of Canada can be found at: *https://women-gender-equality.canada.ca/en/free-to-be-me/2slgbtqi-plus-glossary.html*.

[b] Note that the term "land" in the First Nations Population Health and Wellness Agenda is defined as "an all-encompassing concept that includes land, water, and the animals and plants and other beings that live on this earth."

Report Acknowledgements

The Provincial Health Officer expresses deep appreciation to the many people who have contributed to this report, including drinking water officers and environmental health officers at the regional health authorities, provincial water protection program and policy staff, and other contributors.

Data and feedback were provided by many individuals and organizations across BC. While not all content contributions can be included, the input received was vital to the development of this final report. The Provincial Health Officer would like to thank the following organizations for lending their expertise and assistance to the Provincial Health Officer's team during the development of this report (alphabetical):

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BC Ministry of Forests
- Integrated Resource Operations Division
- Resource Stewardship Division

BC Ministry of Health
- Climate Resilience Unit
- Population and Public Health
- Emergency Management Unit

BC Ministry of Municipal Affairs (Local Government Division)

BC Ministry of Transportation and Infrastructure (Integrated Transportation and Infrastructure Services Division)

BC Ministry of Water, Land and Resource Stewardship (Water, Fisheries, and Coast Division)

British Columbia Energy Regulator

Environmental Operators Certification Program

First Nations Health Authority

Fraser Health

Indigenous Services Canada

Interior Health

Island Health

Northern Health

Provincial Health Services Authority
- BC Centre for Disease Control
- BC Centre for Disease Control Public Health Laboratory
- Enhanced Water Quality Assurance Program
- Health Emergency Management BC

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REFERENCES

[1] Government of British Columbia. Declaration on the Rights of Indigenous Peoples Act [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 May 15]. Available from: *https://www2.gov.bc.ca/gov/content/governments/indigenous-people/new-relationship/united-nations-declaration-on-the-rights-of-indigenous-peoples*.

[2] United Nations General Assembly. United Nations Declaration on the Rights of Indigenous Peoples. [Internet]. United Nations General Assembly; 2007 Oct 2 [cited 2023 May 15]. Available from: *https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf*.

[3] Waters S. Environment – The ecosystem is our health system. In: Visioning the future: First Nations, Inuit and Métis population and public health. [Internet]. Prince George, BC: National Collaborating Centre for Indigenous Health; Dec 2021 [cited 2023 May 15]. Available from: *https://www.nccih.ca/Publications/Lists/Publications/Attachments/10351/Visioning-the-Future_EN_Web_2021-12-14.pdf*.

[4] United Nations Declaration of the Rights of Indigenous Peoples Act [S.C. 2021, c. 14] [statute on the Internet]; [cited 2023 May 15]. Available from: *https://laws-lois.justice.gc.ca/eng/acts/U-2.2/page-1.html*.

[5] Press Office of the Holy See. Joint statement of the dicasteries for culture and education and for promoting integral human development on the "Doctrine of Discovery". [Internet]. Vatican City: Press Office of the Holy See; 2023 Mar 30 [cited 2023 May 15]. Available from: *https://press.vatican.va/content/salastampa/en/bollettino/pubblico/2023/03/30/230330b.pdf*.

[6] Government of British Columbia. Declaration Act Action Plan [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 May 15]. Available from: *https://www2.gov.bc.ca/gov/content/governments/indigenous-people/new-relationship/united-nations-declaration-on-the-rights-of-indigenous-peoples/implementation*.

[7] Truth and Reconciliation Commission of Canada. Truth and Reconciliation Commission of Canada: calls to action. [Internet]. Ottawa, ON: Truth and Reconciliation Commission of Canada; 2015 [cited 2023 May 15]. Available from: *https://www2.gov.bc.ca/assets/gov/british-columbians-our-governments/indigenous-people/aboriginal-peoples-documents/calls_to_action_english2.pdf*.

[8] National Inquiry into Missing and Murdered Indigenous Women and Girls. Reclaiming power and place: the final report of the National Inquiry into Missing and Murdered Aboriginal Women and Girls. [Internet]. Vancouver, BC: Privy Council office; 2019 [cited 2023 May 15]. Available from: *https://www.mmiwg-ffada.ca/final-report/*.

[9] Government of British Columbia. Declaration on the Rights of Indigenous Peoples Act Action Plan 2022–2027. [Internet]. Victoria, BC: Government of British Columbia; 2022 Mar 30 [cited 2023 May 16]. Available from: *https://www2.gov.bc.ca/assets/gov/government/ministries-organizations/ministries/indigenous-relations-reconciliation/declaration_act_action_plan.pdf*.

[10] First Nations Health Authority and Office of the Provincial Health Officer. First Nations Population Health and Wellness Agenda. [Internet]. First Nations Health Authority and Office of the Provincial Health Officer; 2021 [cited 2023 May 16]. Available from: *https://www.fnha.ca/Documents/FNHA-PHO-First-Nations-Population-Health-and-Wellness-Agenda.pdf*.

Executive Summary

This report, produced by the Provincial Health Officer (PHO), covers the programs and activities for the 2017/18 through 2021/22 fiscal years, and includes an update to the recommendations from our previous report: *Clean, Safe, and Reliable Drinking Water: An Update on Drinking Water Protection in BC and the Action Plan for Safe Drinking Water in British Columbia (2012/13–2016/17)*. This report is intended to be read by people with responsibilities in the oversight and operation of drinking water supply systems and by members of the public who have an interest in drinking water protection. The report has been informed by the findings of the BC Auditor General and continues the transition in how the PHO is reporting on drinking water in BC. It provides an update on the indicators introduced in the previous PHO drinking water report and largely follows a structure for drinking water in BC that is consistent with a multi-barrier approach. It is worth mentioning that investments in drinking water system improvements that occurred during this reporting period may not be reflected in this report because those improvements take time to complete.

This report also captures a rare event—the COVID-19 global pandemic. Public health measures were necessary to reduce COVID-19 infections, hospitalizations, and deaths; however, they also had many other consequences, including impacts on health authority drinking water programs and water suppliers in BC. This report looks at some of these impacts, including health authority and water supplier staffing shortages; difficulties in collecting, transporting, and analyzing drinking water samples; and reductions in drinking water system inspections. Mitigation strategies are also documented, such as arranging alternative courier networks to transport water samples, implementing point-of-use testing of water samples in remote areas that do not have laboratory access, and establishing an online Help Centre for BC small water systems. It is likely that residual impacts such as a backlog in inspections and environmental health officer staffing shortages will continue to challenge drinking water programs, including meeting the PHO recommendation for reporting by 2024.

In addition, between April 1, 2017 and March 31, 2022, BC experienced several unprecedented floods, fires, droughts, and heat events that led to widespread impacts across the province and damage to critical infrastructure, such as water supply systems. These events stressed supply chains, and laboratory transportation networks, and limited regional health authority staff availability for routine work as they responded to the emergencies. Impacted water suppliers suffered extensive and costly damage to their systems that required assessments and assistance beyond that which the suppliers had the capacity to contend with. These events demonstrated the clear need for further provincial disaster preparedness, response, and recovery planning and coordination for drinking water to better equip drinking water officers, water suppliers, local governments, First Nations, laboratories, and the Province to respond. Officials identified mutual aid agreements, mapping of critical infrastructure, and greater clarity in processes for accessing funds for recovery as tools to better support drinking water suppliers in responding to climate-related disasters.

These extraordinary environmental stressors were layered on top of other complex issues in the BC drinking water landscape. A large number of water systems in BC are regulated under the *Drinking Water Protection Act* (DWPA). As of March 31, 2022, there were 4,968 recorded water systems across the province, 93 per cent of which were small water systems (i.e., water supply systems that serve less than 500 people in a 24-hour period). Small water systems can face multiple challenges due to operational, financial, and governance factors. It should be noted, however, that while most water systems in the province are small, the majority of the province's population is served by a small number of larger, local government water systems that are known to provide clean, safe, and reliable drinking water.

In order to monitor the diversity of water systems in the province, consistent information flow is critical. Despite some improvements in the past few years, managing and collecting information on drinking water and source water supplies continues to be a challenge in BC. Work is ongoing within regional health authorities to adapt their information systems to collect the indicators introduced in the previous PHO drinking water report or adopt a more comprehensive information technology solution that supports consistent data collection across all regional health authorities. At this time, half the regional health authorities are using data systems that have reached end-of-life status and require replacement soon. This makes it very challenging for those regional health authorities to get the software vendor to invest time in modifying their data systems to allow them to better report out on all the PHO indicators or implement new indicators. Until the regional health authorities can implement these changes, the PHO's capacity to report on drinking water program activities remains limited. However, even with these limitations, the data provided by the regional health authorities for this report enabled the PHO, for the first time, to provide counts on the different types of community water systems, stand-alone facility water systems, and water sources, as well as data on the duration of water advisories and reasons for those advisories. During this reporting period, the Ministry of Health (HLTH) launched a project to explore options for developing a drinking water information module as part of the future Environmental Health Information System. As the development of this report progressed, HLTH began work with key partners, including the Office of the Provincial Health Officer and the regional health authorities, to standardize key data elements for drinking water systems in order to implement the Drinking Water Information System module. The PHO indicators are included in data elements for this project.

Laboratory testing is another critical part of ensuring water quality, and laboratory accreditations and audits continue to be conducted and reviewed by technical experts in the Enhanced Water Quality Assurance (EWQA) Program. Over this reporting period, two new laboratories in the province were approved for microbiological water testing. Efforts were undertaken to address the limited laboratory services within remote and rural areas by piloting a point-of-use testing program. Due to the challenges of COVID-19, the EWQA Program cancelled on-site laboratory audits for new and established PHO-approved laboratories in July 2020.[1] To support laboratories in becoming certified to test drinking water samples, EWQA adapted its on-site audit process to a virtual process.[2] EWQA conducted eight virtual audits in 2021 and 2022.[3]

Much of the data in this report comes from routine inspections. Drinking water officers conduct these on a frequency that is based on risk and factors such as number of users, system complexity, and compliance history. Achieving the capacity to meet inspection targets while also continuing engagement and outreach activities has been difficult for many of the regions due to staffing shortages, travel distances, and the large number of small water systems with complex administrative, financial, and compliance challenges. Both the COVID-19 pandemic response and climate-related emergencies exacerbated this, which resulted in a large backlog of inspections. For the 2021/22 fiscal year, only 20 per cent of permitted water systems across the province were inspected by the regional health authorities because of staffing shortages and the backlog of routine work caused by the pandemic. This is in contrast to a 60 per cent provincial inspection rate in 2019/20, just prior to pandemic disruptions. While inspection targets do not usually require annual routine inspections of water systems (i.e., it is not expected that 100 per cent of water systems be

inspected each year), this 40 per cent decrease in annual inspections reflects the challenges in completing routine work during this period.

To move from data to action to protect drinking water and source water, abatement and enforcement programs are critical. The increase in the number of regulated drinking water systems, coupled with workforce shortages due to demographic shifts and staffing challenges at some regional health authorities, suggest that ensuring fulfillment of the mandate to protect drinking water for the province is becoming significantly more challenging. Since the previous PHO drinking water report, the number of regulated drinking water systems has increased by 143. Over this same period, the number of full-time equivalent (FTE) environmental health officers who carry out the functions of a drinking water officer has decreased marginally from 33.5 to 32.1 FTEs. This leaves, on average, 155 water systems that must be monitored and inspected per environmental health officer FTE (an increase from 144 systems per FTE previously). Similarly, there are, on average, 621 water systems per public health engineer in the province. In addition, these statistics do not represent actual staffing levels because many environmental health officer positions were vacant as of March 31, 2022 due to the unique staffing challenges faced by the regional health authorities (such as staff being reassigned to pandemic response roles); estimated staffing reductions varied from 40 per cent to 80 per cent, depending on the region. Given the importance of clean, safe, and reliable drinking water and the increasing complexity and demands on drinking water protection programs across the province, a strategic review of drinking water program priorities and the development of new initiatives and resources may be required to allow regional health authorities to complete the work necessary for ensuring the delivery of safe drinking water in their communities.

From 2017 through to 2021, one outbreak of a drinking water-related illness was reported at a remote recreational location within a national park. Despite this occurrence, confirmed cases of illness related to drinking water have largely remained stable in BC. More than 350,000 water samples were submitted to approved laboratories for bacteria testing during the reporting period. Less than half of 1 per cent tested positive for *E. coli*. The detection of bacteria in a water sample from systems not currently on a boil water notice prompts a risk assessment and investigation by a drinking water officer to determine the appropriate response, which may include a boil water notice.

Unfortunately, boil water notices, water quality advisories, and do not use notices increased over the reporting period from 691 on March 31, 2018 to 803 on March 31, 2022, which may be a result of many factors ranging from the increase in capacity challenges for small water systems, aging infrastructure, and new manganese thresholds to more comprehensive monitoring, testing, and reporting. While the number of water systems increased marginally over the reporting period, this does not appear to have been a main driver in the increase in advisories during this period.

A portion of these advisories likely occurred as a result of climate-related events that affected the province during this reporting period. Most notably, yearly wildfires and the significant flooding in the Lower Mainland and Interior region in 2021 displaced many residents and affected the critical infrastructure needed to produce safe drinking water. The good news is that many of the advisories over the reporting period were resolved in a timely manner: 50 per cent were resolved within one month of their issuance, and 20 per cent were resolved between one and six months. The large number of advisories is also a reflection of the level of involvement drinking water officers have with the increasing number of small water systems, which are also the most vulnerable to the effects of climate change.

On March 31, 2022, 561 advisories had been in place for more than 18 months, and 345 of them had been in place for five years or more. Progress is gradually being made on resolving long-term advisories, although their complexity makes resolution difficult. Most advisories are occurring in regions that have a large number of small water systems, which face multiple complex challenges. Regional health authorities have begun tracking the reason(s) why advisories are issued. Preliminary information indicates that untreated water at risk of pathogens was the most common reason for issuing an advisory, followed by unacceptable water quality

results. Source water deterioration, insufficient treatment, water quality parameter exceedances, and inadequate operations and maintenance were other significant reasons for issuing a drinking water advisory. As noted previously, recent extreme climate impacts are also likely contributors to the issuance of some drinking water advisories.

During this reporting period, several new guidance documents for drinking water were developed by both Health Canada and HLTH. Health Canada developed or updated 27 water quality parameters for the *Guidelines for Canadian Drinking Water Quality* and six guidance documents. HLTH developed guidelines for both lead and manganese based on the guidelines released by Health Canada in 2019, which introduced a lower health-based maximum acceptable concentration (MAC) value for both parameters.[4,5] Other guidance documents HLTH developed to support water suppliers and drinking water officers include the *Guidelines for Ultraviolet Disinfection of Drinking Water,*[6] *Guidelines for Pathogen Log Reduction Credit Assignment,*[7] *Design Guidelines for Drinking Water Systems in British Columbia,*[8] *Guide to Emergency Response and Contingency Plans for Water Supply Systems,*[9] and *Guide for Communicating with Water Users.*[10]

As a result of the new guideline values for lead and manganese, many water systems now exceed the MAC for lead within building plumbing or for manganese. Sampling for lead in drinking water at schools and child care facilities is ongoing across the province. An increase in water quality advisories related to elevated manganese has occurred since 2019, particularly in Northern Health. Manganese is an essential element in the human diet; however, recent studies have suggested that high levels in drinking water may increase the risk of harming brain development in infants and young children.[11] In response, Northern Health contacted water suppliers with more than 15 connections, and other priority systems (potential high-risk populations) that had sample data that exceeded the MAC for manganese, and directed them to advise water users who prepared powdered formula for bottle-feeding infants to use an alternative source of potable water until improvements could be made to the system to reduce manganese levels.[12]

More than five years have passed since the end of the reporting period of the last PHO drinking water report released in 2019. During that time, the Province and those involved in the protection and delivery of safe drinking water have experienced a global pandemic, supply chain shortages, catastrophic floods, and other climate-related emergencies such as droughts, wildfires, and heat events. Every one of these emergencies has created challenges for drinking water suppliers and those responsible for the protection of drinking water. Despite these challenges, the Province and the regional health authorities have made significant progress in advancing many of the 32 recommendations in the 2019 PHO drinking water report. Government agencies have completed six recommendations, implementation of 14 recommendations is in progress, and action on five recommendations is ongoing. However, no action has been taken on seven recommendations.

Most notably, the Province completed two of three priority recommendations related to the governance of drinking water and made progress on the third. HLTH completed a review of the existing governance structure of drinking water protection, specifically source water protection, and made recommendations to government for a new governance model for source water protection. This work helped inform the restructuring of the natural resource sector and led to the creation of the Ministry of Water, Land and Resource Stewardship (WLRS) in 2022. The new ministry was assigned the mandate for source water protection and for providing leadership on the coordination and development of a new Source-to-Tap Strategy for drinking water in BC.

In 2021, prior to the creation of WLRS, HLTH and PHO began developing a project plan for engaging with partners on the development of a new strategic plan for safe drinking water. The strategic plan was intended to replace the 2002 Action Plan. Since the announcement of the new ministry, staff from HLTH and WLRS have been working closely to make progress on source water protection, small water systems, and governance.

During this reporting period, the Province established several executive-level committees to facilitate broader interagency collaboration

and coordination on water. WLRS is leading the development of the Watershed Security Strategy (WSS), which has included engagement with First Nations, local governments, agencies, and interested parties. The WSS was announced as a mechanism to build on, align with, and complement the current work across government to help ensure BC's watersheds are healthy. WLRS, with the First Nations Fisheries Council, also convened the BC–First Nations Water Table to support the Province and First Nations in identifying, discussing, and making consensus-based, co-developed recommendations to provincial and First Nations decision-makers about matters of mutual interest. The Water Table has been asked to co-develop the WSS. In March 2023, the Province invested $100 million in the co-development of a Watershed Security Fund. The money has been transferred to the Real Estate Foundation of BC, which will be responsible for co-developing the Watershed Security Fund with First Nations. This process is intended to honour BC's commitment to true, lasting reconciliation and to align with the United Nations Declaration on the Rights of Indigenous Peoples and the *Declaration on the Rights of Indigenous Peoples Act*, 2019.[13]

Since the last PHO drinking water report was issued, a legislative framework review has been completed by HLTH and the Ministry of Environment and Climate Change Strategy (ENV). The Ministry of Forests (FOR)[a] has updated various pieces of legislation to help protect drinking water (Recommendation 4). In 2021, HLTH and the PHO began an assessment of the effectiveness of drinking water protection plans (Recommendation 5). This work will be continued by WLRS. No action was taken by ENV, HLTH, or FOR to address regulatory conflicts between the DWPA and the *Water Sustainability Act* to prevent the creation of small water systems (Recommendation 6). As of April 2022, ENV's role in this work has been passed to WLRS. Similarly, the Ministry of Municipal Affairs has not yet undertaken a review of the waiver of public assent for borrowing processes related to the installation of treatment work for local government drinking water systems under the Municipal Liabilities Regulation in the *Community Charter* (Recommendation 7).

The 2019 PHO drinking water report outlined the financial and management capacity issues that face small water systems, and called for the development of a small water system strategy, including plans to encourage and facilitate small water system acquisition, improvement district conversion, and improved processes regarding the incorporation and dissolution of water users' communities and utilities. During this reporting period, little progress was made in developing a small water system strategy that addressed these recommendations (Recommendation 9–12). Although work on a small water system strategy has not commenced, HLTH and regional health authorities continue to make incremental steps toward improving the state of small water systems, including providing educational outreach opportunities to small water system operators and owners. In 2019, HLTH provided a contract to the BC Water and Waste Association to develop an online community network, including a free course for small water system operators that describes the basics of system ownership and associated responsibilities.[14]

Most people who live in BC consistently enjoy clean, safe, reliable drinking water; however, more can be done to improve the protection of drinking water from source to tap, particularly for small water systems that are not owned or operated by a local government. In addition, a targeted effort is needed to support regional health authorities and water suppliers to catch up on overdue routine inspection and compliance work that could not be completed during the response to the COVID-19 pandemic. The following 20 recommendations are offered to advance drinking water quality and protection across BC. Fifteen of these recommendations are refreshed updates to recommendations in the 2019 PHO drinking water report that were in progress or outstanding at the end of this reporting period (March 31, 2022); five are new. The status of each recommendation (new or refreshed from the 2019 report) is indicated, along with the lead agency or ministry responsible for the recommendation. While some recommendations have a clear provincial ministry or agency lead, others will require cross-ministry and cross-agency partnerships and collaboration.[b]

[a] On October 19, 2023, after completion of this report, responsibility for the administration of water, land, fish, and wildlife was transferred from the Ministry of Forests (FOR) to the Ministry of Water, Land and Resource Stewardship. This transfer included the Water Management Branch and the Comptroller of Water Rights, which are referred to as being part of FOR throughout this report.

[b] The "Lead" is the primary ministry or partner agency that has responsibility for the program area specified in the recommendation and should report on activities undertaken in support of the recommendation. Any ministry or partner agency working in "collaboration" will be supporting the efforts of the Lead, and is not expected to report on activities unless requested to by the Lead. Refreshed recommendations are adapted from the 2019 Provincial Health Officer drinking water report.

Short-term priority recommendations from the perspective of the PHO include addressing emergency response planning and climate change resilience for drinking water (Recommendations 5 and 6) and ensuring that drinking water protection programs are adequately resourced (Recommendation 15). Medium- to long-term priorities include the development of a provincial Source-to-Tap Strategy (Recommendation 1) that includes a small water system strategy (Recommendation 12), completion of a provincial, interoperable data system for drinking water (Recommendation 10), and review and modernization of the DWPA and source water protection tools (Recommendation 3, 4, and 16).

RECOMMENDATIONS

Recommendation 1: Action Plan and Memorandum of Understanding

Develop the Source-to-Tap Strategy to replace the *Action Plan for Safe Drinking Water in British Columbia*. Develop a formalized agreement on interagency coordination to replace the 2006 Memorandum of Understanding regarding inter-agency accountability and coordination on drinking water protection, and recommit to modernized principles and actions across government.

Lead: *Ministry of Water, Land and Resource Stewardship, in collaboration with the Ministry of Health*

Status: *Refreshed – adapted from Recommendation 2 – In Progress*

Recommendation 2: Roles and Responsibilities for Drinking Water on Federal Land

Clarify roles and responsibilities for the oversight of drinking water and the authority of the BC *Drinking Water Protection Act* on federal lands and in federal facilities (e.g., national parks, airports and other ports, border crossings, Royal Canadian Mounted Police detachments, and other federal buildings) to ensure adequate oversight and protection of public health in relation to drinking water.

Lead: *Ministry of Health, in collaboration with the Ministry of Water, Land and Resource Stewardship*

Status: *New*

Recommendation 3: Legislative Review of the *Drinking Water Protection Act*

Conduct a legislative review of the *Drinking Water Protection Act* to:

Identify amendments to address ongoing small water system challenges, climate change resilience, source water protection, and the Province's commitment to the *Declaration on the Rights of Indigenous Peoples Act*.

Lead: *Ministry of Health, in collaboration with the Ministry of Water, Land and Resource Stewardship*

Status: *New*

Recommendation 4: Drinking Water Protection Plans

a. Complete a comparative review of planning tools that can assist in drinking water source protection under the *Water Sustainability Act, Drinking Water Protection Act, Environmental Management Act,* and *Forests and Range Practices Act*.

b. Complete a review of the objectives and effectiveness of drinking water protection plans under the *Drinking Water Protection Act* as a water source and system protection tool to determine if changes to the Act could enable more collaborative, proactive, and legally binding protection.

c. After completion of 4.a and 4.b, develop guidance that outlines the criteria for when a drinking water protection plan is appropriate and what steps must be taken by the drinking water officer and the Provincial Health Officer before making a recommendation to the Minister.

Lead: *Ministry of Water, Land and Resource Stewardship, in collaboration with the Provincial Health Officer, Ministry of Health, and regional health authorities*

Status: *Refreshed – adapted from Recommendation 5 – In Progress*

Recommendation 5: Climate Resiliency and Emergency Response

Develop a provincial drinking water disaster preparedness, response, and recovery plan that includes First Nations water suppliers and:

a. Clarifies roles and responsibilities for drinking water during an emergency.

b. Plans for the provision of drinking water in the event of widespread infrastructure damage, loss of water source, severe drought or water scarcity, or widespread contamination that cannot be removed by treatment.

Lead: *Ministry of Water, Land and Resource Stewardship, in collaboration with the Ministry of Emergency Management and Climate Readiness, Ministry of Health, and Ministry of Municipal Affairs, and First Nations*

Status: *New*

Recommendation 6: Climate Change Resiliency and Adaptation

Create and implement collaborative and proactive opportunities to improve climate change resiliency of water supply systems and the drinking water protection program.

Lead: *Ministry of Health, in collaboration with the Ministry of Water, Land and Resource Stewardship, Comptroller of Water Rights, Ministry of Environment and Climate Change Strategy, Ministry of Municipal Affairs, and regional health authorities*

Status: *New*

Recommendation 7: Regulatory Conflict Pertaining to the Authorization of Joint Works and Water Users' Communities

Address the regulatory conflict between the *Drinking Water Protection Act, Water Sustainability Act,* and *Water Users' Communities Act* by conducting the following:

a. Review the definitions of "water supply systems", "water users' communities", "waterworks purpose", and "domestic use" across all statutes, and identify options to harmonize the definitions that consider public health protection, ecosystem protection, small water system capacity, and prevention of unsustainable water supply systems.

b. Review the processes for authorizing the construction of joint works used for drinking water across the statutes, and identify options to coordinate approval processes to prevent the creation of small water supply systems without all the necessary approvals.

Lead: *Ministry of Water, Land and Resource Stewardship, in collaboration with the Ministry of Health and the Comptroller of Water Rights*

Status: *Refreshed – adapted from Recommendation 6 – No Action Taken*

Recommendation 8: Public Assent Processes and the Community Charter

Review the waiver of public assent for borrowing processes related to the installation of treatment works for local government drinking water systems under the Municipal Liabilities Regulation in the *Community Charter*. Identify an alternative strategy to remove barriers to borrowing for necessary infrastructure improvements while also providing a streamlined opportunity for public assent. As part of this review, consider the liquid/solid waste management plans under the *Environmental Management Act* as models.

Lead: *Ministry of Municipal Affairs*

Status: *Refreshed – adapted from Recommendation 7 – No Action Taken*

Recommendation 9: Implementation of Drinking Water Indicators for Annual Reporting

Adapt health authority data systems to:

a. Align data fields and data collection with the indicators for drinking water and water system categories that were developed collaboratively by the Provincial Health Officer and regional health authorities, and begin reporting these data by the end of 2024.

b. Effectively track drinking water program activities under the *Drinking Water Protection Act*, including inspections, investigations, enforcement actions, reconsideration of decisions, and drinking water officer engagement and interactions with water suppliers, operators, local governments, and the public.

Lead: *Regional health authorities*

Status: *Refreshed – adapted from Recommendations 8a and 32 – In Progress*

Recommendation 10: Provincial Information Management/Information Technology Strategy

Complete the development of the provincial Drinking Water Information System (as part of the larger provincial Environmental Health Information System) and implement it. Ensure data fields are relevant, reliable, consistent, and accessible and build on the indicators and water system categories developed collaboratively by the Provincial Health Officer, regional health authorities, and Ministry of Health. When developing the Drinking Water Information System module:

a. Develop standardized data collection and entry guidance for the Drinking Water Information System module that is supported by standardized business and inspection processes. This guidance should include direction on what information and requirements must be met to be able to report out on the Provincial Health Officer indicators for the multi-barrier approach (i.e., source water protection, robust treatment, distribution integrity, monitoring and reporting, and operations and management).

b. Develop a process within the Drinking Water Information System to uniformly review water systems to identify those that do not meet the BC surface water or groundwater treatment objectives and to inform the assessment of risk for water systems. This assessment will inform the development of financial plans and compliance processes to meet the treatment objectives and will help identify where resources should be directed to reduce risk and achieve identified target dates for infrastructure improvements.

c. Develop and resource an action plan and strategy to make drinking water chemistry data for water supply systems that are analyzed by private laboratories available as part of a provincial data system.

d. Identify necessary data fields and plan for future interoperability with other provincial databases to support the assessment of risk of drinking water sources from a quality and quantity perspective.

Lead: *Ministry of Health, in collaboration with the regional health authorities, Ministry of Water, Land and Resource Stewardship, Ministry of Municipal Affairs (10.b), and Ministry of Environment and Climate Change Strategy (10.d)*

Status: *Refreshed – adapted from Recommendations 8b, 14, and 25 – In Progress*

Recommendation 11: Water Quality Data Sharing

Complete the development of an enhanced data platform to share source water quality monitoring data among agencies that have responsibilities for source water protection.

Lead: *Ministry of Environment and Climate Change Strategy, in collaboration with the Ministry of Water, Land and Resource Stewardship*

Status: *Refreshed – adapted from Recommendation 26 – In Progress*

Recommendation 12: Small Water System Strategy

Develop a provincial small water system strategy as part of a provincial Source-to-Tap Strategy (Recommendation 1) with interagency commitment to:

a. Prevent the creation of new unsustainable small water systems during subdivision development.

b. Promote amalgamation and acquisition of small water systems.

c. Support and encourage improvement district conversion.

d. Build the capacity and sustainability of existing small water systems.

e. Identify opportunities to strengthen the governance of improvement districts, private water utilities, water users' communities, and other small water systems, and identify processes to support the quick conversion and dissolution of such systems when their governance structure fails or falls into receivership or escheat.

Lead: *Ministry of Water, Land and Resource Stewardship, in collaboration with the Ministry of Health, Comptroller of Water Rights, Ministry of Municipal Affairs, and Ministry of Transportation and Infrastructure*

Status: *Refreshed – adapted from Recommendations 9 – In Progress and 10–12 – No Action Taken*

Recommendation 13: Operator Training for Small Water Systems and Bulk Water Haulers

Develop a minimum recommended standard of training and competencies for small water system operators and bulk water haulers. Standards for small water systems should consider their varying sizes, levels of complexity, water sources, and governance structures.

Lead: *Ministry of Health, in collaboration with the regional health authorities*

Status: *Refreshed – adapted from Recommendation 22 – No Action Taken*

Recommendation 14: Access to Approved Laboratories

Develop and resource a strategic approach to:

a. Support improved access to water testing in remote and rural areas. This includes but is not limited to exploring the use of Level C laboratories and point-of-use testing for microbiological indicators, and partnering with neighbouring First Nations community-based monitors.

b. Prepare a continuity plan for a routine microbiological water quality sampling program in BC for disruptions caused by climate-related or other types of emergencies that may disrupt laboratory supply chains, staffing, transportation networks, access to communities, sample pickup locations, or access to laboratories.

Lead: *BC Centre for Disease Control Public Health Laboratory, in consultation with the Ministry of Health, regional health authorities, and First Nations Health Authority*

Status: *Refreshed – adapted from Recommendation 27 – In Progress*

Recommendation 15: Drinking Water Program Resources and Training Requirements

a. Determine the extent of the current backlog of inspections and routine work in each region, and identify the resources required to mitigate the backlog.

b. Provide support and opportunities for the regional health authorities to catch up on the current backlog of inspections and assessments with water suppliers.

c. Review the resources and training needed by the Ministry of Health, Provincial Health Officer, regional health authorities, and Ministry of Water, Land and Resource Stewardship staff to effectively fulfill their roles under the *Drinking Water Protection Act* going forward, including incorporating the impacts that climate-related emergencies will continue to have on program resource requirements, and provide sufficient resources and a framework for training to meet these mandates.

Lead: *15.a Regional health authorities; 15.b Ministry of Health; 15.c Ministry of Health, in collaboration with the Provincial Health Officer, regional health authorities, and Ministry of Water, Land and Resource Stewardship*

Status: *Refreshed – adapted from Recommendations 29 and 30 – In Progress*

Recommendation 16: Source Water Risk Assessment Framework

a. Develop a provincial framework for assessing risks to drinking water sources that is based on accurate data on source waters, drinking water system and intake locations, and known hazards.

b. Contingent upon the completion of the provincial framework (16.a), review existing source and system assessment tools and guidance for water suppliers (e.g., the *Comprehensive Drinking Water Source-to-Tap Assessment Guideline, Drinking Water Source-to-Tap Screening Tool, Water System Assessment User's Guide*) to identify areas for modernization and improvement, and develop guidance for drinking water officers on which type of water source and system assessment is required for different types and sizes of water suppliers.

Lead: *16.a Ministry of Water, Land and Resource Stewardship, in collaboration with the Ministry of Health; 16.b Ministry of Health, in collaboration with the Ministry of Water, Land and Resource Stewardship, and regional health authorities*

Status: *New*

Recommendation 17: Distribution System Integrity and Maintenance

Develop provincial guidance for drinking water officers regarding the assessment of distribution system integrity, management, cross-connection control, corrosion, and maintenance that considers the varying sizes, capacities, and complexities of water systems. Using this guidance as a basis, develop common inspection processes and data collection requirements for the assessment of distribution system integrity and maintenance.

Lead: *Ministry of Health, in collaboration with regional health authorities*

Status: *Refreshed – adapted from Recommendation 16 – In Progress*

Recommendation 18: Asset Management and Financial Planning

a. Develop guidance for drinking water officers on the essential elements of asset management plans and financial plans for different types of water systems that can be referenced during an inspection or assessment of the management of a water system.

b. Using this guidance as a basis, develop common inspection processes and data collection requirements with the regional health authorities for the assessment of this indicator of water system management.

Lead: *18.a Ministry of Municipal Affairs, in collaboration with the Ministry of Health; 18.b Ministry of Health, in collaboration with the regional health authorities*

Status: *Refreshed – adapted from Recommendation 24 – In Progress*

Recommendation 19: Bulk Water Haulers

Develop provincial guidance for bulk water haulers to reflect current regulatory requirements and best practices.

Lead: *Ministry of Health, in collaboration with the regional health authorities*

Status: *Refreshed – adapted from Recommendation 20 – No Action Taken*

Recommendation 20: Investigating Threats to Drinking Water

Develop further guidance on investigating threats to drinking water under section 29 of the *Drinking Water Protection Act*. This guidance should clarify the scope of section 29 investigations where assessments are required outside of the capacity of the health authority (e.g., hydrogeological assessments).

Lead: *Ministry of Health, in collaboration with the Ministry of Water, Land and Resource Stewardship and the regional health authorities*

Status: *Refreshed – adapted from Recommendation 31 – In Progress*

REFERENCES

[1] BC Centre for Disease Control. EWQA onsite audits – postpone June audits [email from C Lee]; 2020 Mar 27.

[2] Enhanced Water Quality Assurance. EWQA virtual audit: remotely assessing laboratory performance. Vancouver, BC: BC Centre for Disease Control Public Health Laboratory; 2020.

[3] Enhanced Water Quality Assurance EWQA virtual audit plan. [Internet]. Vancouver, BC: BC Centre for Disease Control Public Health Laboratory; 2020.

[4] BC Ministry of Health. Guidelines on evaluating and mitigating lead in drinking water supplies, schools, child care facilities and other buildings. [Internet]. Victoria, BC; BC Ministry of Health; 2019 [cited 2023 Mar 13]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_b_-_12_evaluating_and_mitigating_lead.pdf*.

[5] BC Ministry of Health. Guidance on manganese in drinking water. [Internet]. Victoria, BC; BC Ministry of Health; 2019 [cited 2023 Mar 13]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_b_-_13_manganese.pdf*.

[6] BC Ministry of Health. Guidelines for ultraviolet disinfection of drinking water. [Internet]. Victoria, BC: BC Ministry of Health; 2022 [cited 2022 May 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/dwog_part_b_-_16_ultraviolet_disinfection_of_drinking_water.pdf*.

[7] BC Ministry of Health. Guidelines for pathogen log reduction credit assignment. [Internet]. Victoria, BC: BC Ministry of Health; 2022 [cited 2022 May 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/dwog_part_b_-_15_pathogen_log_reduction_credit_assignment.pdf*.

[8] BC Ministry of Health. Design guidelines for drinking water systems in British Columbia. [Internet]. Victoria, BC; BC Ministry of Health; 2023 [cited 2023 May 11]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_b_-_17_design_guidelines_for_drinking_water.pdf*.

[9] BC Ministry of Health. Guide to emergency response and contingency plans for water supply systems. [Internet]. Victoria, BC; BC Ministry of Health; 2023 [cited 2023 May 11]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/guide_to_emergency_response_and_contingency_plans_for_water_supply_systems.pdf*.

[10] BC Ministry of Health. Guide for communicating with water users. [Internet]. Victoria, BC; BC Ministry of Health; 2023 [cited 2023 May 11]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/guide_for_communicating_with_water_users.pdf*.

[11] Health Canada. Guidelines for Canadian drinking water quality: guideline technical document – manganese. [Internet]. Ottawa, ON: Health Canada; 2019 [cited 2023 May 30]. Available from: *https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-manganese.html*.

[12] Northern Health Authority. NH Health Protection and Disease Prevention (HPDP) Program update, elevated manganese in drinking water - guidance process, June 2020 [email from S Wadden]; 2020 Jun 17.

[13] BC Ministry of Water, Land and Resource Stewardship. Watershed strategy co-developed with First Nations, $100 million invested. [Internet]. Victoria, BC: BC Ministry of Water, Land and Resource Stewardship; 2023 May 06. Available from: *https://news.gov.bc.ca/releases/2023WLRS0008-000267*.

[14] BC Ministry of Health. Response to request for data in support of the PHO report [email from M Om Prakash]; 2022 Apr 12.

Inside the new Comox Valley Water Treatment Plant.

Photo credit: Comox Valley Regional District.

PART 1:

Drinking Water – The BC Framework

Part 1 introduces the framework for drinking water protection in BC—the multi-barrier approach. Chapter 1 outlines what a water supply system is, and the agency roles and responsibilities involved in the protection of drinking water. Chapter 2 provides an overview of the number and types of drinking water systems in BC, their sources, and some of the challenges they face.

CHAPTER

1

Introduction

Ensuring that the public has access to clean, safe, and reliable drinking water is imperative for public health. Protecting this resource is no small task and involves interagency coordination across different levels of government, ministries, communities, and non-government organizations. Drinking water in British Columbia comes from numerous groundwater and surface water sources, each with their own unique considerations for source protection, treatment, and distribution. In addition, water systems vary in size, type, ownership, and governance. Urban areas most often have large systems, whereas people living in other parts of the province receive water from small water systems. The goal of drinking water programs is to ensure that the quality of drinking water is maintained for all people who live in BC. The following section shares the BC drinking water framework from the government and public health perspective.

1.1 What is a Water Supply System?

In BC, any water supply system that serves more than a single-family residence is regulated as a drinking water supply system under the *Drinking Water Protection Act* (DWPA).[1] Therefore, any residential water supply with two or more connections, or any commercial, recreational, or industrial water supply where water is provided or offered for domestic purposes qualifies as a public water supply and requires a permit to operate, which is issued by the local drinking water officer. The only type of water system that does not require a permit under the DWPA is a water supply system that serves a single-family residence. Those unregulated systems (commonly referred to as "private water systems") are not inspected or monitored by the regional health authorities and therefore are not included in this report. As of March 31, 2022, there were 4,968 recorded water systems across the province, 93 per cent of which were small water systems. Small water systems are defined under the Drinking Water Protection Regulation as drinking water systems that serve 500 people or less in a 24-hour period.

1.2 Legislation Pertaining to Drinking Water Protection

The protection and oversight of drinking water sources and drinking water systems is a shared interagency responsibility in BC. The roles and responsibilities for drinking water protection federally, provincially, and locally were outlined in detail in the 2019 Provincial Health Officer (PHO) report, *Clean, Safe, and Reliable Drinking Water: An Update on Drinking Water Protection in BC and the Action Plan for Safe Drinking Water in British Columbia*.[2] As outlined in that report, the DWPA is the principal statute concerning drinking water protection and remains the responsibility of the Ministry of Health (HLTH) to administer and the regional health authorities to enforce. While the DWPA is the principal statute regarding drinking water quality from water suppliers, it is only one of many pieces of legislation that are important in the management and protection of drinking water. Other statutes include, but are not limited to, the *Public Health Act,* the *Water Sustainability Act,* the *Environmental Management Act,* the *Forest and Range Practices Act,* the *Local Government Act,* the *Community Charter,* the *Water Utility Act,* the *Utilities Commission Act,* and the *Water Users' Communities Act*. Because many government agencies are involved in aspects of drinking water protection,

the *Action Plan for Safe Drinking Water in British Columbia* (the Action Plan) called for coordination and integration of these functions and for clear lines of responsibility within government.[3] HLTH, the PHO, and the regional health authorities continue to work closely together and with other government ministries and water supply organizations to ensure the health of the public is protected from threats to drinking water. While there are no new responsibilities for HLTH and the regional health authorities for drinking water protection, responsibility for the overall leadership for provincial strategic direction and coordination has shifted to a new ministry since our last report. This change, as well as other organizational and ministry changes since 2019, are described below.

1.3 Ministry of Water, Land and Resource Stewardship

In October 2020, the natural resource sector ministers established the Lands and Natural Resource Operations Secretariat to determine whether land use objectives that support economic activity, environmental sustainability, and reconciliation with Indigenous Peoples could be more effectively achieved through ministry restructuring. Introduced in January 2021, the Secretariat was charged with developing restructuring options for government.[4]

On February 25, 2022, the Province announced a restructuring of the natural resource sector with the creation of the Ministry of Land, Water and Resource Stewardship, effective April 1, 2022. This reorganization was followed up by an additional change on December 7, 2022, in which the ministry was renamed the Ministry of Water, Land and Resource Stewardship (WLRS). The provincial government mandated the Minister of WLRS to "provide Provincial leadership on water policy and strategies including the coordination of government's Source to Tap Strategy to protect drinking water". The Source-to-Tap Strategy will refresh the Province's direction on, and establish a multi-barrier approach to, safe drinking water in BC. WLRS will develop the Source-to-Tap Strategy in consultation with ministries and partners, and will clarify responsibilities in source water protection. Strategy development will include planning for emergency response, land use, and risk mitigation; small water systems; monitoring and reporting; and treatment and distribution system infrastructure and financing.

HLTH, the PHO, and regional health authorities will maintain accountabilities for the DWPA and regulation. The PHO will continue its mandate to ensure government's accountability for drinking water, including oversight and reporting on progress and trends in source-to-tap drinking water protection. While HLTH maintains responsibility for the DWPA, on April 25, 2023, during the production of this report, WLRS, HLTH, and the PHO signed a Memorandum of Understanding that section 4.1 (Annual drinking water protection report), 4.2 (Reports respecting problems related to provincial government actions), and Part 5 (Drinking Water Protection Plans) of the Act would be assigned to the WLRS Minister.[5] Now, the PHO will provide direct reports under section 4.1 and 4.2 to the WLRS Minister, and make recommendations for drinking water protection plans to the WLRS Minister. On October 19, 2023, responsibility for these sections was transfered to the WLRS Minister through Order in Council No. 568.

The Ministry of WLRS's mandate represents a significant change in accountability for drinking water protection in the province.[a] While HLTH, the PHO, and the regional health authorities maintain their role in administering the DWPA, the accountability for leadership and coordination of the provincial strategy for drinking water protection now rests with a new ministry within the natural resource sector. This change brings with it clarity on roles and responsibilities for source water protection, which was identified as a gap in our previous report. It also brings drinking water protection firmly within the natural resource sector mandate.

The creation of WLRS was not only a pivotal change for the governance of drinking water protection, it also resulted in other changes within the natural resource sector. Responsibilities for water protection and sustainability (including source water protection); aquatic ecosystems; and fisheries, aquaculture, and wild salmon shifted from the Ministry of Environment and Climate Change Strategy (ENV) and the former Ministry of Forests, Lands, Natural Resource Operations and Rural Development

[a] Drinking water protection is complex and involves federal, provincial, and local governments, health authorities, First Nations, and other agencies. Chapter 2 of the 2019 PHO report *Clean, Safe, and Reliable Drinking Water: An Update on Drinking Water Protection in BC and the Action Plan for Safe Drinking Water in British Columbia* provides an overview of the various roles and responsibilities of these various agencies in BC prior to the creation of the Ministry of Water, Land and Resource Stewardship.

(FLNRORD) to WLRS. Also, within the restructuring of FLNRORD, the responsibilities of the Water Management Branch, the Comptroller of Water Rights, and regional operations for land use decisions, water allocations, and water utilities and water users' communities passed to the new Ministry of Forests (FOR)[b]; however, in 2023, an additional restructuring occurred as described in the text box below. ENV maintained responsibility for environmental protection and regional operations under the *Environmental Management Act* (EMA), and for the Climate Action Secretariat, environmental assessment, and environmental monitoring and analysis.[6,7,8] Another noteworthy change included as part of the government restructuring in 2022 was the creation of the new Ministry of Emergency Management and Climate Readiness (EMCR). EMCR is now BC's lead coordinating agency for all emergency management activities, including preparedness, response, recovery, and mitigation.[9]

1.4 Role and Mandate of the Provincial Health Officer

The PHO is the senior public health official for BC. The PHO is responsible for monitoring the health of BC's population and for providing independent advice on public health issues to the ministers and public officials. The *Public Health Act* outlines most of the responsibilities of the PHO. The PHO also holds oversight and accountability for drinking water protection under the DWPA. According to the Act, the duties of the PHO include monitoring compliance of drinking water officers (DWOs) with guidelines and directives established under the Act, preparing and delivering an annual report to the WLRS and Health Minister regarding activities under the Act, reporting on issues that threaten public health by negatively impacting drinking water, making recommendations to the Minister of WLRS with regard to drinking water protection plans, and reviewing decisions of DWOs. The PHO also provides recommendations for improving the protection of drinking water in BC.

Under section 4.1 of the DWPA, the PHO must prepare a report on the activities conducted under the Act for the past year.[1] The PHO has historically reported on the Action Plan, which was then combined with the annual activities conducted under the DWPA into a single report that covered multiple fiscal years. This PHO drinking water report covers activities conducted under the Act for fiscal years 2017/18 to 2021/22. It also includes an update to the recommendations from our previous report, *Clean, Safe, and Reliable Drinking Water: An Update on Drinking Water Protection in BC and the Action Plan for Safe Drinking Water in British Columbia* (2012/13–2016/17). This report also features significant events during this reporting period that impacted water suppliers, the public, and provincial drinking water protection programs—a global pandemic and climate-related events, such as floods, wildfires, drought, and extreme heat.

1.5 Auditor General Report

In July 2019, the Office of the Auditor General (OAG) released *The Protection of Drinking Water: An Independent Audit*, which provided eight recommendations for HLTH and the PHO to improve drinking water protection as it relates to public health.[10] Specific to this report, recommendation 8 of the OAG audit recommended the following:

> Monitor progress and trends in the protection of drinking water and report on a timely basis to the Minister of Health and the Legislative Assembly on whether activities are mitigating risks.[10]

This recommendation is based on section 4.1 of the DWPA, which states that:

Provincial Government Re-organization Update

On October 19, 2023, after completion of this report, responsibility for the administration of water, land, fish, and wildlife was transferred from the Ministry of Forests (FOR) to the Ministry of Water, Land and Resource Stewardship. This transfer included the Water Management Branch and the Comptroller of Water Rights, which are referred to as being part of FOR throughout this report.

[b] For the remainder of this report, FLNRORD will be referred to by its current name, FOR.

Photo credit: Courtesy of BC Legislature.

> (1) The Provincial Health Officer must prepare and deliver to the minister an annual report respecting activities under this Act for the past year.
>
> (2) After receiving an annual report under subsection (1),
>
> (a) the minister must promptly lay the report before the Legislative Assembly if it is in session, or
>
> (b) if the Legislative Assembly is not in session, the minister must file the report with the Clerk of the Legislative Assembly.[1]

The OAG audit determined that while PHO drinking water reports had been issued for most fiscal years, they were not released annually as required by the Act.[10] Up to and including the report in 2019, the PHO released drinking water reports that covered several fiscal years due to challenges with staffing resources; collecting data from partner ministries, agencies, and regional health authorities; and accessing information in a timely manner.

In response to this recommendation from the OAG, the PHO committed to continue work already underway to refine and improve how we monitor progress and trends in the protection of drinking water through our new reporting structure and indicators.[11] Going forward, the PHO intends to release short annual reports that are limited to activities conducted under the DWPA, as per section 4.1 of the Act, in addition to its larger reports on progress and trends in the protection of drinking water in BC. Larger reports would be released every few years to align with the time frame required for progress in drinking water infrastructure improvements. While this shift will comply with the recommendations from the OAG, its success will depend on the successful development of a provincial drinking water information system, the implementation of the PHO indicators by the regional health authorities, and the provision of data to the PHO in a timely manner. The PHO requests data annually from the regional health authorities, as per section 4.1 of the DWPA. Due to staffing limitations and data system challenges, receiving data from the regional health authorities and completing an internal PHO staff review for completeness and errors takes many months.

1.6 The Multi-barrier Approach to Drinking Water

The multi-barrier approach is a system of procedures, processes, and tools that collectively prevent or reduce the contamination of drinking water from source to tap to reduce risks to human health (*Figure 1.1*). The multi-barrier approach has become the recognized best practice of most jurisdictions, including BC, to ensure the availability of clean, safe, and reliable drinking water from source to tap.[12]

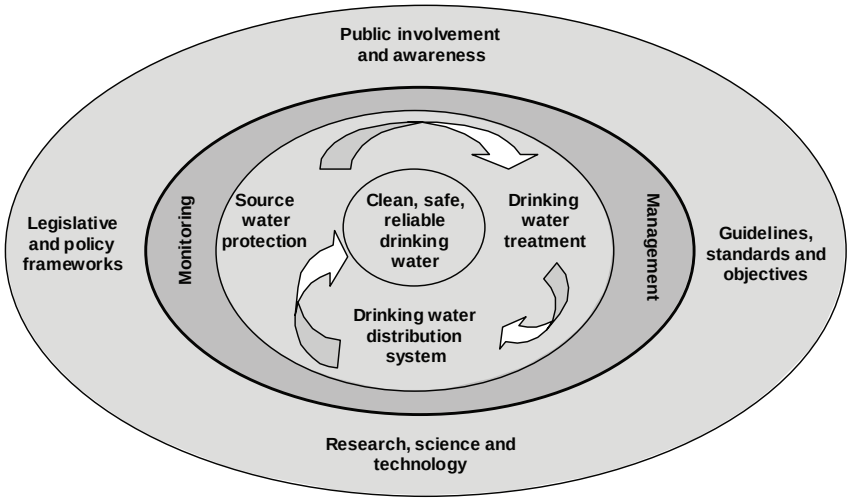
The inner circle of *Figure 1.1* shows the desired outcome of this approach: clean, safe, reliable drinking water. The inner ring identifies the three core elements of this approach to ensure the availability of safe drinking water from source to tap: source water protection, drinking water treatment, and drinking water distribution system integrity. These core elements must be managed as a whole—as multiple layers of protection, or a multi-barrier approach—because no single element alone can guarantee clean, safe, reliable drinking water.

Monitoring and management, the middle ring of *Figure 1.1*, refers to the integrated system of total quality management that is necessary to support the three core elements. This system includes monitoring, reporting, good operations and management, and abatement and enforcement programs. The outer ring of *Figure 1.1* refers to those elements that support the system of total quality management, including legislative and policy frameworks; guidelines, standards, and objectives; the development of research, science, and technology; and public involvement and awareness. The content and organization of this report aligns with the multi-barrier approach.

1.7 Water System Data

Access to accurate and timely data on water systems is an essential component of maintaining water system safety and quality. Unfortunately, the ability of regional health authorities to extract meaningful information from their data systems to measure progress on implementing the key elements of the multi-barrier approach continues to be limited. This challenge was highlighted in previous PHO drinking water reports. Recognizing this limitation, the PHO initiated a project in 2014 in partnership with the regional health authorities and HLTH to revise water system categories and create a new suite of indicators to better track progress on the implementation of the multi-barrier approach. In 2015, the project team developed new, draft drinking water system categories and indicators that align with the multi-barrier approach. Using the new indicators and water system categories, the PHO will be

Figure 1.1: The Multi-barrier Approach to Safe Drinking Water



Source: Canadian Council of Ministers of the Environment. From source to tap: the multi-barrier approach to safe drinking water; 2002.

in a better position to assess and report on abatement and enforcement activities under the DWPA.

HLTH is leading the development of a provincial Drinking Water Information System (DWIS) as part of the larger provincial Environmental Health Information System. HLTH is also working collaboratively with partners, including the PHO and the regional health authorities, to standardize key drinking water data elements for the DWIS module. The proposed PHO indicators are included in data elements for this project.

This report includes a subset of the new indicators that were presented in the 2019 PHO drinking water report, *Clean, Safe, and Reliable Drinking Water: An Update on Drinking Water Protection in BC and the Action Plan for Safe Drinking Water in British Columbia*.[2] Efforts to align the indicators with regional health authority data systems were proceeding up until 2020/21, when the impacts of COVID-19 caused staffing shortages. This in turn resulted in delays in reporting data to the PHO and triggered a temporary halt in reporting on the new indicators in order to help the regional health authorities complete their 2020/21 data submissions. Once the work to improve drinking water information systems and incorporate all the new indicators has been completed, drinking water reports will include the comprehensive list of drinking water system indicators, which currently are only partially implemented by the regional health authorities.

1.8 Organization of Report

This report is organized into seven parts with 12 chapters in total.

Part 1 (Chapters 1-2) – Introduces and describes the different types of water supply systems in BC.

Part 2 (Chapters 3-4) – Reviews the multi-barrier approach to drinking water protection and discusses source water assessments and protection plans in addition to treatment and distribution objectives for water systems.

Part 3 (Chapters 5-7) – Discusses good operations and management, addresses monitoring and reporting, presents public notification data regarding drinking water quality, reviews water program resources, and examines abatement and enforcement programs.

Part 4 (Chapter 8) – Highlights drinking water protection challenges for small water systems and bulk water haulers, and provides a summary of flexible options for small water systems under the DWPA.

Part 5 (Chapters 9-10) – Examines the impacts of the COVID-19 pandemic and climate change on water suppliers, regional health authority drinking water programs, and other partner agencies.

Part 6 (Chapter 11) – Discusses progress made on previous recommendations.

Part 7 (Chapter 12) – Introduces and discusses new recommendations.

Water systems that serve First Nations communities are not under provincial jurisdiction; however, information on drinking water in First Nations communities has been included in sections of this report. First Nations leadership works in partnership with Indigenous Services Canada and the First Nations Health Authority to provide safe and sustainable drinking water supplies in First Nations communities, following federal guidelines and provincial guidelines and regulations as best practice. The First Nations Health Authority acts as a data steward for First Nation communities and adheres to the First Nations principles of ownership, control, access, and possession. Summary information is provided to the PHO for the annual report.[13]

Several landmark events related to Indigenous rights and truth and reconciliation took place shortly before and during the period relevant to drinking water protection in BC. In 2014, the Supreme Court decided *Tsilhqot'in Nation v. British Columbia*, which recognized that Aboriginal title and rights extend beyond reserve land.[14] In 2015, testimony of thousands of residential school survivors and their descendants provided 94 clear instructions to reset relationships with Indigenous Peoples, which was followed by 231 more from the National Inquiry into Missing and Murdered Indigenous Women and Girls.[15,16] In 2016, Canada officially removed its permanent objector status to the United Nations Declaration on the Rights of Indigenous Peoples, which was followed by BC and the federal government signing this framework into law in 2019 and 2021, respectively.[17] We acknowledge that these obligations are not yet fully upheld within the PHO's responsibility for drinking water protection or this report.

REFERENCES

[1] Drinking Water Protection Act [SBC 2001, c.9] [statute on the Internet]; [cited 2022 Jun 14]. Available from: *http://www.bclaws.ca/civix/document/id/complete/statreg/01009_01*.

[2] BC Office of the Provincial Health Officer. Clean, safe, and reliable drinking water: an update on drinking water protection in BC and the action plan for safe drinking water in British Columbia 2019. [Internet]. Victoria, BC: BC Office of the Provincial Health Officer; 2019 [cited 2021 Nov 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/pho-drinking-water-report-2019.pdf*.

[3] BC Ministry of Health Planning, BC Ministry of Health Services. Action plan for safe drinking water in British Columbia. [Internet]. Victoria, BC: BC Ministry of Health Planning, BC Ministry of Health Services; 2002 [cited 2022 Apr 25]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/safe_drinking_printcopy.pdf*.

[4] North, A. Personal communication. BC Ministry of Water, Land and Resource Stewardship; 2023 Oct 31.

[5] Government of British Columbia. Memorandum of Understanding between the PHO, Ministry of Health, Ministry of Water, Land and Resource Stewardship regarding reporting relationships between the PHO, the Minister of WLRS and the Minister of HLTH under sections 4.1, 4.2 and Part 5 of the DWPA. Victoria, BC: Government of British Columbia.

[6] Government of British Columbia. Ministry of Environment and Climate Change Strategy. [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 Mar 15]. Available from: *https://www2.gov.bc.ca/gov/content/governments/organizational-structure/ministries-organizations/ministries/environment-climate-change*.

[7] Government of British Columbia. Ministry of Forests. [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 Mar 15]. Available from: *https://www2.gov.bc.ca/gov/content/governments/organizational-structure/ministries-organizations/ministries/forests*.

[8] Government of British Columbia. Ministry of Water, Land and Resource Stewardship. [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 Mar 15]. Available from: *https://www2.gov.bc.ca/gov/content/governments/organizational-structure/ministries-organizations/ministries/water-land-and-resource-stewardship*.

[9] Government of British Columbia. Ministry of Emergency Management and Climate Readiness. [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 Mar 15]. Available from: *https://www2.gov.bc.ca/gov/content/governments/organizational-structure/ministries-organizations/ministries/emergency-management-and-climate-readiness*.

[10] BC Office of the Auditor General. The protection of drinking water: an independent audit report. [Internet]. Victoria, BC. BC Office of the Auditor General; 2019, Jul [cited 2022 Apr 21]. Available from: *https://www.bcauditor.com/sites/default/files/publications/reports/OAGBC_Protection-of-Drinking-Water_RPT.pdf*.

[11] BC Ministry of Health. Ministry of Health Action Plan and Progress Assessment (APPA) for the implementation of audit recommendations from the OAG [Prepared for the Select Standing Committee of Public Accounts]. [Internet]. Victoria, BC: BC Ministry of Health; 2019 [cited 2022 Aug 18]. Available from: *https://www.leg.bc.ca/content/CommitteeDocuments/41st-parliament/4th-session/pac/20191217_GovtActionPlan_Drinking-Water.pdf*.

[12] Canadian Council of Ministers of the Environment. From source to tap: guidance on the multiple-barrier approach to safe drinking water. [Internet]. Winnipeg MB: Federal-Provincial-Territorial Committee on Drinking Water and the CCME Water Quality Task Group; 2004 [cited 2022 Jun 14]. Available from: *https://ccme.ca/en/res/sourcetotap-finalenglish03-28-04.pdf*.

[13] First Nations Health Authority. Response to request for updates to the status of drinking water in British Columbia [email from R Fleming]; 2022 Oct 21.

[14] Supreme Court of Canada. Tsilhqot'in Nation v. British Columbia [Internet]; 2014 Jun 26. Available from: *https://scc-csc.lexum.com/scc-csc/scc-csc/en/item/14246/index.do*.

[15] Truth and Reconciliation Commission of Canada. Calls to action. [Internet]; 2015. *Available from: https://www2.gov.bc.ca/assets/gov/british-columbians-our-governments/indigenous-people/aboriginal-peoples-documents/calls_to_action_english2.pdf*.

[16] National Inquiry into Missing and Murdered Indigenous Women and Girls. Calls for justice [Internet]. Available from: *https://www.mmiwg-ffada.ca/wp-content/uploads/2019/06/Calls_for_Justice.pdf*.

[17] CBC News. Canada officially adopts UN declaration on rights of Indigenous Peoples [Internet]; 2016 May 10. Available from: *https://www.cbc.ca/news/indigenous/canada-adopting-implementing-un-rights-declaration-1.3575272*.

CHAPTER

2

Types of Water Systems

A large number of water systems (4,968) are regulated in BC. While the majority of water systems in the province are small (93 per cent), most of the province's population is served by a small number of larger local government water systems, such as the Metro Vancouver water system and the Capital Regional District water system. This chapter presents a review of the number and types of water systems in BC, their water sources, and some of their specific challenges. Additionally, presented in limited form is the number of water systems based on the new categories developed through the Provincial Health Officer (PHO) indicator project.

2.1 Types of Water Systems and System Categories

Water systems, ranging from the large and complex to the small and simple, are regulated under the *Drinking Water Protection Act* (DWPA). Small water systems in BC include many types of systems that serve a variety of communities (e.g., subdivisions, rural neighbourhoods, public facilities, and commercial enterprises). Water systems can be publicly or privately owned, or jointly owned by a group of users. The population served may be transient or non-transient, and the primary use of the water may be for residential, industrial, recreational, or institutional facilities or developments.

The PHO and the regional health authorities have developed new categories for reporting on water systems based on the size of the population served (*Table 2.1*), the source (*Table 2.2*), and the type of community water system (*Table 2.3*) or stand-alone facility served (*Table 2.4*). In rural areas, facilities are often not connected to community water systems; they provide their own water supply through their own well or surface intake. The PHO refers to these types of water systems as "stand-alone facility water systems". The type of system can greatly influence the financial management, governance, and oversight of the system. It can also reflect the type of population using the water (i.e., transient or non-transient, residential or non-residential, or vulnerable populations [i.e., immunocompromised people, children, and the elderly]). While some regional health authority data systems have been adapted to collect this information, not all can report on the new categories at present. As such, the PHO intends to report on the aforementioned water systems in future reports.

Table 2.1: Water System Categories Based on the Size of the Population Served

Small Water Systems (≤500 people served per day)		Large Water Systems (>500 people served per day)			
≤ 50 people served per day	51–500 people served per day	501–5,000 people served per day	5,001–10,000 people served per day	10,001–100,000 people served per day	>100,000 people served per day

Source: BC Office of the Provincial Health Officer (PHO). Water system categorization guidance for PHO report purposes; 2019.

Table 2.2: Water System Categories Based on the Source Type that Serves the System

Surface water	Groundwater	Combined groundwater and surface water	Bulk supplied from an approved source (trucked or piped)

Source: BC Office of the Provincial Health Officer (PHO). Water system categorization guidance for PHO report purposes; 2019.

Table 2.3: Water System Categories Based on the Type of Community Water System

Water System Type		Water System Sub-type	
Local Government Water System	Any community water system that falls under the *Local Government Act* (LGA). This includes municipalities, regional districts, and improvement districts. These water systems have governance and financial requirements provided by the LGA and the *Community Charter*, with oversight provided by the Ministry of Municipal Affairs (MUNI).	**Municipal**	Any community water system owned and/or operated by a municipality.
		Regional District	Any community water system owned and operated by a regional district. Regional districts are the local government for unincorporated areas and may provide governance and services such as drinking water to regions as a whole, such as Metro Vancouver.
		Improvement District	Any community water system owned and operated by an improvement district. Improvement districts—which include irrigation and waterworks districts—are independent public corporations that provide limited services, such as drinking water or fire protection, in rural (unincorporated) areas of the province. They may exist within the boundaries of a municipality or regional district but operate independently.
Developments Incorporated by the Comptroller of Water Rights	Any community water system incorporated by the Comptroller of Water Rights at the Ministry of Forests (FOR).[a]	**Utility**	Utilities are water systems that are built by developers in areas where no existing water service is available. A utility provides water in exchange for compensation to five or more persons or a corporate facility (such as a ski resort). Utilities are regulated under the *Water Utility Act* and the *Utilities Commissions Act* and may be set up under several different business/ownership models, including a strata corporation, a society, a corporation, an individual, or a partnership. The Comptroller of Water Rights and the Utility Regulation section of FOR provide oversight on governance and financing.
		Water Users' Community	Water users' communities are a specific type of community water system that draws its system of governance and incorporation from the *Water Users' Communities Act* (formerly Part 3 of the *Water Act*). They are a public corporate body to which the Comptroller of Water Rights has issued a Certificate of Incorporation. Six or more different licensees may form a water users' community, each of whom holds their own water licence(s).
Independents	Independent water systems include residential developments that have no administrative or financial oversight from the Comptroller of Water Rights or MUNI. Independents are not regulated as a utility, a water users' community, an improvement district, a regional district, or a municipality. Examples include subdivisions, mobile home parks, shared interest properties, apartment buildings, and shared systems between neighbours.	**Strata Corporation**	Community water systems that are owned and operated by a strata corporation, where the governance of the water system falls under the *Strata Property Act*, not the *Water Utility Act*. Most strata developments are built as a utility, but once most of the lots are sold, the Comptroller may approve the transfer of ownership from the developer to the strata corporation and exempt the strata from the *Water Utility Act* to avoid regulatory duplication.

continued next page

[a] On October 19, 2023, after completion of this report, responsibility for the administration of water, land, fish, and wildlife was transferred from the Ministry of Forests (FOR) to the Ministry of Water, Land and Resource Stewardship. This transfer included the Water Management Branch and the Comptroller of Water Rights, which are referred to as being part of FOR throughout this report.

Table 2.3: Water System Categories Based on the Type of Community Water System (continued)

Water System Type		Water System Sub-type	
Independents (cont'd)	Independent water systems include residential developments that have no administrative or financial oversight from the Comptroller of Water Rights or MUNI. Independents are not regulated as a utility, a water users' community, an improvement district, a regional district, or a municipality. Examples include subdivisions, mobile home parks, shared interest properties, apartment buildings, and shared systems between neighbours.	**Private Corporation/ Registered Business**	Community water systems that are owned and operated by a private company run as a corporation, partnership, or sole proprietorship but do not meet the definition of a utility.
		Private Owner (Individual)	A water supply system owned and operated by an individual property owner serving water to tenants or neighbouring properties for domestic use. The owner of these systems has no formal business model and is not incorporated or registered as a company under any Act. The users of the water are not co-owners of the system.
		Joint (User) Ownership – incorporated	Community water systems that are jointly owned and managed by the owners of the properties/residences the water system serves. The owners/users of these systems have incorporated to run their water system as a society or cooperative association. These jointly owned water systems are not a strata and are not regulated as a utility or a water users' community.
		Joint (User) Ownership – "Good Neighbour System"	Community water systems that are jointly owned by the users of the system. These systems are unincorporated and have no formalized business model or governance structure for making decisions and operating their water system. They are commonly known as "good neighbour water systems" and may have some form of a joint works agreement or easements.

Source: BC Office of the Provincial Health Officer (PHO). Adapted from the water system categorization guidance for PHO report purposes; 2019

Table 2.4: Water System Categories Based on the Type of Stand-alone Facility Water System

Industrial/Commercial Facilities	**Work Camps –** Industrial or commercial premises in which structures used for employee living quarters are provided. These water supply systems are also regulated by the Industrial Camps Regulation under the *Public Health Act*.
	Work Sites – Industrial or commercial work sites that supply drinking water for domestic use to workers or the public from their own water supply system.
Recreational Facilities	**Publicly Owned –** Recreational areas, tourist attractions, and accommodations with a water supply system that provides domestic water to visitors, and is owned by a provincial, federal, or local government. Examples include provincial parks, national parks, city parks, recreational areas, campgrounds, picnic grounds, government-owned tourist attractions, and rest areas.
	Privately Owned – Privately owned recreational and tourist facilities and accommodations. Examples include privately owned hotels, motels, inns, bed & breakfasts, resorts, camps, campgrounds, RV parks, water parks, golf courses, ski hills, racetracks, fairgrounds, and tourist attractions.
Public Health Facilities	Includes facilities that are regulated by public health officials under the *Public Health Act, Food Safety Act,* or *Community Care and Assisted Living Act*. They include food facilities (regulated through environmental health programs) and community care facilities (regulated through licensing programs) that provide their own water supply and therefore are subject to the *Drinking Water Protection Act* (DWPA) as water suppliers. Health care facilities designated under the *Hospital Act* that provide their own water supply are also included.
Schools	Includes all schools (public and independent) that provide kindergarten to Grade 12 education and use water from a private source. The school district or the independent school is the water supplier under the DWPA.
Civic and Community Facilities and Institutions	Includes buildings that are used to provide a service or public benefit. Examples include libraries, post offices, jails, community centres, town halls, event centres, churches, post-secondary institutions, and vocational training centres. Facilities that rely on their own private water supply are considered water suppliers under the DWPA. These civic facilities may be publicly or privately owned.

Source: BC Office of the Provincial Health Officer (PHO). Water system categorization guidance for PHO report purposes; 2019.

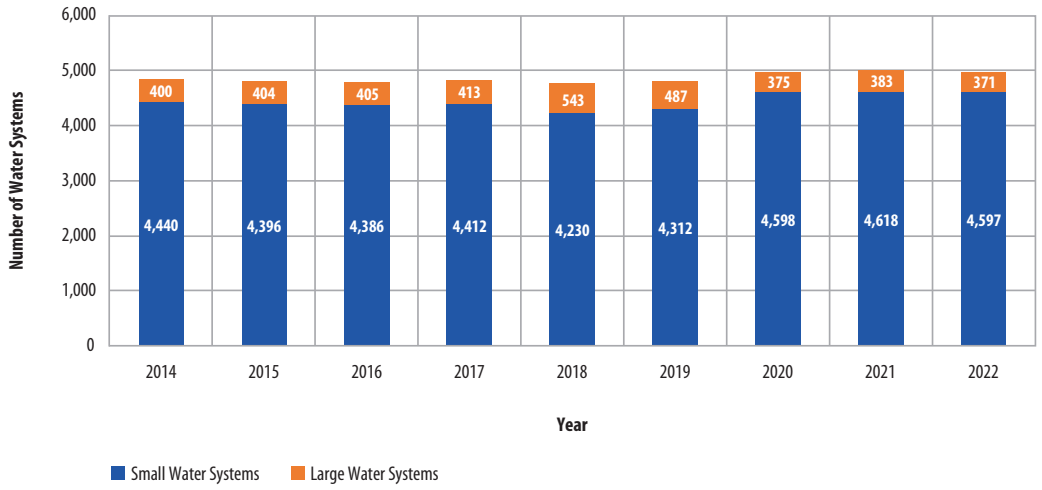
These categories will better reflect the use and capacity of different water systems and will allow officials to highlight the challenges, successes, and issues they face. The ability to analyze the collected data by the specific type of water system, its size, or its source will provide a greater understanding of existing issues and make it easier to develop targeted programs to address those issues.

2.2 Summary of Water Systems in BC

2.2.1 Water System Size

The number of water systems in BC has continued to grow since our last report, with a peak of 5,001 water systems recorded in 2021 (*Figure 2.1*). The 2019 PHO drinking water report stated that there were 4,825 water systems on March 31, 2017.[1] By March 31, 2022, the number had increased by 3 per cent to 4,968; however, the number of systems in 2022 declined slightly from the peak in 2021. *Table 2.5* shows the number of recorded water systems in the province from March 31, 2018 to March 31, 2022, categorized by size. As of March 31, 2022, 93 per cent of water systems in BC were considered to be small; however, most of the population in the province continues to be served by a small number of larger local government water systems.

Figure 2.1: Number of Small and Large Water Systems, BC, as of March 31, 2014 to 2022



Note: Small water systems serve 500 people or fewer in a 24-hour period. Large water systems serve more than 500 people in a 24-hour period.

Source: Regional health authorities; 2013/14–2021/22.

Table 2.5: Number of Small and Large Water Systems, by Regional Health Authority, BC, as of March 31, 2018 to 2022

Regional Health Authority	2018			2019			2020			2021			2022		
	Small	Large	Total	Small	Large	Total	Small	Large	Total	Small	Large	Total	Small	Large	Total
Island Health	839	91	**930**	841	93	**934**	902	89	**991**	908	88	**996**	861	88	**949**
Northern Health	986	153	**1,139**	986	153	**1,139**	1,178	62	**1,240**	1,197	62	**1,259**	1,192	63	**1,255**
Vancouver Coastal Health	248	100	**348**	302	49	**351**	332	34	**366**	322	40	**362**	330	37	**367**
Interior Health	1,755	156	**1,911**	1,773	153	**1,926**	1,776	151	**1,927**	1,790	150	**1,940**	1,822	146	**1,968**
Fraser Health	402	43	**445**	410	39	**449**	410	39	**449**	401	43	**444**	392	37	**429**
Total	**4,230**	**543**	**4,773**	**4,312**	**487**	**4,799**	**4,598**	**375**	**4,973**	**4,618**	**383**	**5,001**	**4,597**	**371**	**4,968**

Note: Small water systems serve 500 or fewer people in a 24-hour period. Large water systems serve more than 500 people in a 24-hour period.

Source: Regional health authorities; 2017/18–2021/22.

Compared to March 31, 2017, the number of large water systems increased by 31 per cent in 2018 and 18 per cent in 2019 (*Figure 2.1*). The number of small water systems decreased marginally over those same years compared to 2017 (4 per cent and 2 per cent, respectively). However, total system counts of both large and small water systems in 2018 and 2019 were consistent with the previous and following years, which suggests that the regional health authorities may have misreported some small water systems as large water systems due to challenges in how the data are extracted from existing data systems. Numbers of large versus small water systems remained relatively stable from 2020 to 2022 but increased slightly for both in 2021. Fluctuations in the number of systems can be further observed based on the entire data set, which may be due to the amalgamation of systems, the result of small commercial systems shutting down and no longer requiring a permit to operate, or the removal of closed files from the database.

Additionally, not all regional health authorities are currently able to accurately make system counts in their data systems based on system size. Instead, they estimate the number of small systems based on the number of connections served. The PHO recognizes the data collection and information system limitations and is working with regional health authorities to improve this parameter for future reports.

2.2.2 Water System Sources

Regional health authorities now also track information on the water source type for water systems they regulate. The data are still incomplete because not every regional health authority has adapted its data system to accurately capture water source types; however, progress is being made in data collection and reporting. The data that are currently available are presented in *Table 2.6*, with the caveat that the data are preliminary and do not completely align with the water systems in *Table 2.5*. Groundwater—single or multiple wells—is the predominant source for water systems across the five regional health authorities that report data (*Table 2.6*). Of the reported source types, 72 per cent are groundwater, 17 per cent are surface water, 8 per cent are bulk water, and 3 per cent are combined surface and groundwater sources (*Figure 2.2*).

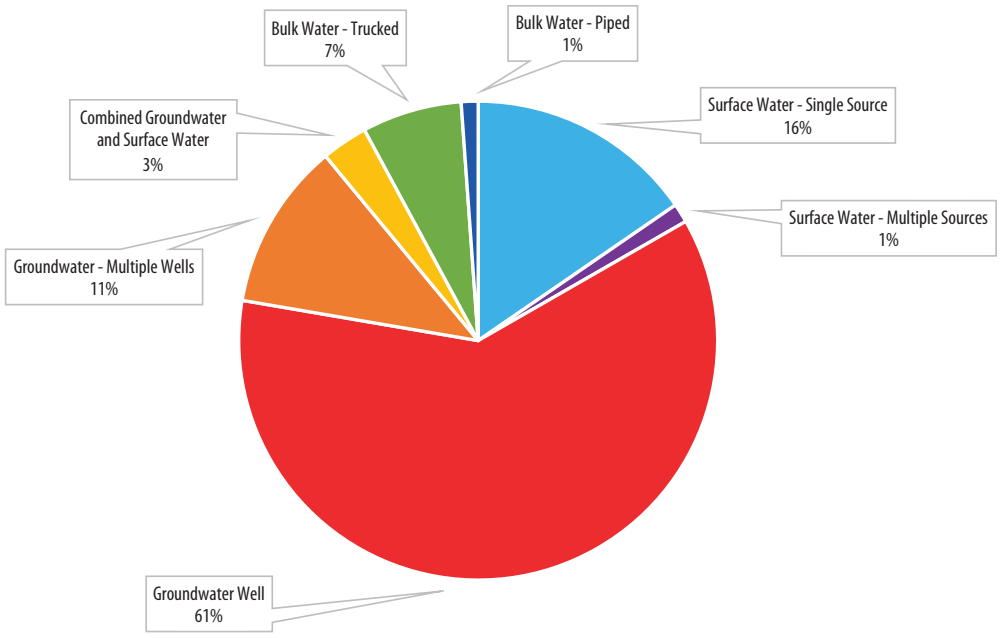
Table 2.6: Number of Water Source Types, by Regional Health Authority, BC, as of March 31, 2022

Regional Health Authority	Surface Water – Single Source	Surface Water – Multiple Sources	Groundwater – Single Well	Groundwater – Multiple Wells	Combined Ground and Surface Water	Bulk Water		Total
						Trucked	Piped	
Island Health	127	10	633	142	59	30	20	**1,021**
Northern Health	9	1	515	111	2	228	6	**872**
Vancouver Coastal Health	108	9	191	42	16	0	3	**369**
Interior Health	323	27	680	113	38	–	–	**1,181**
Fraser Health	30	3	343	30	6	3	15	**430**
Total	**597**	**50**	**2,362**	**438**	**121**	**261**	**44**	**3,873**

Note: Interior Health was not able to report on the source water type for bulk water haulers.

Source: Regional health authorities; 2021/22.

Figure 2.2: Percentage of Water System Source Types, BC, as of March 31, 2022



Source: Regional health authorities; 2021/22.

2.2.3 Community Water Systems

For the first time, the PHO is able to report out partially on the number of community water systems based on data provided by the regional health authorities. *Table 2.7* shows the number of community water systems by regional health authority as of March 31, 2022. Note that in some cases, regional health authorities were able to report only by the base water system type rather than sub-type because data systems are still being altered to track these system types. This limited data set indicates a varied arrangement of water systems due to the unique requirements of each regional health authority. That said, regional districts comprise most local government water systems, and private corporations and private owners comprise most non-local government water systems. Data on the number of community water systems will be expanded upon in future PHO reports.

Regional health authority data on water system type are still limited; however, data on improvement districts are available from the Ministry of Municipal Affairs (MUNI), and data on water utilities and water users' communities are available from the Comptroller of Water Rights, as described below.

2.2.4 Improvement Districts

As of March 31, 2022, there were 190 improvement districts across BC (*Table 2.8*), and 153 of them provided drinking water (*Figure 2.3*). More than 50 per cent of the total number of improvement districts are in Interior Health, 31 per cent are in Island Health, and the remaining regional health authorities each have less than 10 per cent.

Table 2.7: Number of Community Water Systems, by Regional Health Authority, BC, as of March 31, 2022

Water System Type	Water System Sub-type	Island Health	Northern Health	Vancouver Coastal Health	Interior Health	Fraser Health
Local Government Water Systems	Municipality	31	30	23	86	32
	Regional Districts	52	8	26	100	19
	Improvement Districts	49	3	13	88	6
Non-local Government Water Systems	Utility	26	0	13	48	4
	Water Users' Community	10	0	3	67	3
	Strata Corporation	39	1	12	67	11
	Private Corporation/ Registered Business	21	30	76	319	30
	Private Owner (Individual)	53	18			30
	Joint (User) Ownership – Incorporated	37	2	17		7
	Joint (User) Ownership – "Good Neighbour System"	16	17	4		8
First Nations Water System Inspected by Regional Health Authorities	–	1	0	0	0	1

Note: Non-local government water systems include water systems that are incorporated by the Comptroller of Water Rights and Independents. Data on numbers of improvement districts, utilities, and water users' communities obtained from the regional health authorities may not align with data provided by the Ministry of Municipal Affairs (MUNI) and Ministry of Forests (FOR) in sections 2.2.4 through 2.2.6 because the regional health authorities are still in the process of adapting their data systems to accurately capture these data. MUNI and FOR data that are provided for improvement districts, utilities, and water users' communities in sections 2.2.4 through 2.2.6 are currently the most accurate. Northern Health identified data inaccuracies for this fiscal year but was unable to correct them in time due to data system limitations. Where regional health authority data systems did not record individual sub-types, combined totals were provided instead.

Source: Regional health authorities; 2021/22.

Table 2.8: Number and Percentage of Improvement Districts, by Regional Health Authority, BC, 2022

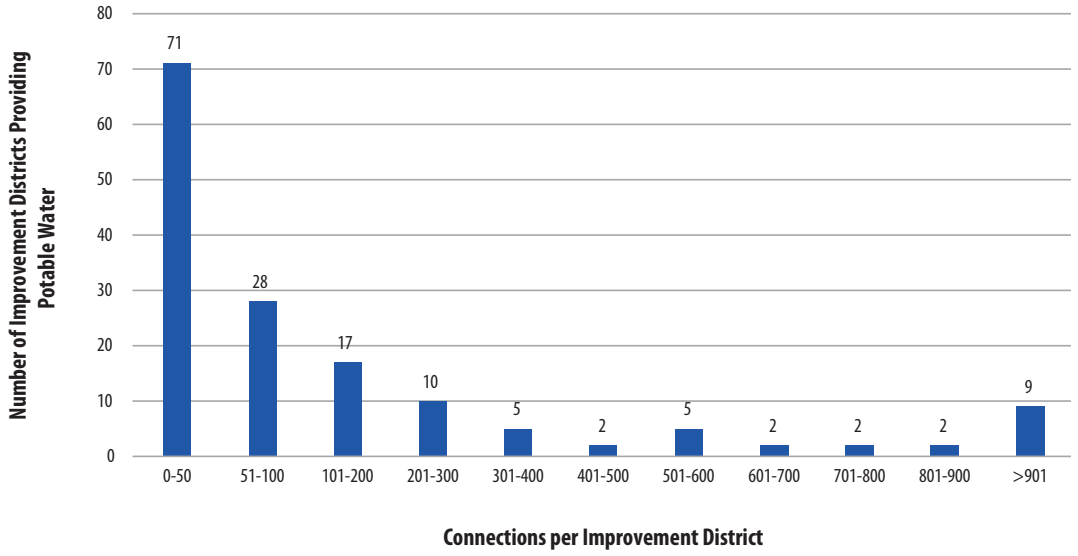
Regional Health Authority	Number
Island Health	59 (31%)
Northern Health	4 (2%)
Vancouver Coastal Health	17 (9%)
Interior Health	98 (52%)
Fraser Health	12 (6%)
Total	**190**

Source: BC Ministry of Municipal Affairs, Local Government Division; 2022.

Improvement districts vary in size, ranging from small subdivisions to larger communities. While some improvement districts can be quite large, most that provide potable water serve a small population (*Figure 2.3*) and face many of the same challenges that small water systems experience.

From 2017 to 2022, there were 16 conversions of improvement districts that provide drinking water, most of which occurred in 2021 (*Table 2.9*). A "conversion" refers to a process conducted through an Order in Council to dissolve and transfer the assets, liabilities, and operation of an improvement district to a local government.[2] Eleven of the conversions occurred within the Interior Health region, four within the Island Health region, and one in the Vancouver Coastal Health region.[3,4] The policy objective of MUNI is to facilitate voluntary conversion of improvement districts and encourage the use of regional districts as the primary option for servicing rural areas.[5]

Figure 2.3: Number of Improvement Districts, by Number of Connections, BC, 2022



Source: BC Ministry of Municipal Affairs, Local Government Division; 2022.

Table 2.9: Improvement District Dissolutions, by Year, BC, 2017 to 2022

Year	Dissolutions	Name of Improvement District
2017	0	–
2018	1	South East Kelowna
2019	1	Lexington
2020	2	South Okanagan Mission; Missezula Lake
2021	8	Florence Lake; Hagensborg; Highland Park; Lansdowne; Larkin; Silver Star; Stardel; Union Bay
2022	4	Eagle Rock; Seagirt; Graham Lake; Okanagan Falls

Note: Dissolutions are tracked by calendar year rather than fiscal year.

Source: BC Ministry of Municipal Affairs, Local Government Division; 2022.

MUNI facilitates voluntary conversion through existing policy, funding programs, and governance work. Governance restructuring support, both advisory and financial, is available through the Ministry. Under the Ministry's existing policy, capital infrastructure grants are open to regional districts and municipalities, and projects for improving water systems that are not owned by these governments are eligible when the system is being transferred to a regional district service area or a municipality. If the grant application is successful, the system must be transferred to a local government (regional district or municipality).[6]

South-east Kelowna residents gather around information boards set up by the City at an open house in 2017, which outlined planned upgrades of the Southeast Kelowna Improvement District water system as part of the Kelowna Integrated Water Project.[7] Citizens from Kelowna receive tap water from a number of large and small water systems. As part of ongoing efforts to improve water quality for everyone and increase resilience, the City of Kelowna is working with partners and communities to integrate and improve systems and infrastructure. In 2017, combined federal and provincial funding of $43.9 million under the Clean Water and Wastewater Fund supported upgrades and integration of two water systems within the City's municipal boundaries. In 2020, the City completed the $86 million project to integrate services in the south end of Kelowna, which resulted in long-term drinking water advisories being lifted for more than 5,000 people, and in services formerly administered by the Southeast Kelowna Improvement District and the South Okanagan Mission Irrigation District being converted to services of the City. Within the municipality, Glenmore-Ellison Improvement District, Black Mountain Irrigation District, and Rutland Water Works improvement districts also supply drinking water.

Photo credit: Black Press Media. Reproduced with permission.[8,9]

Although the number of improvement districts has decreased, it is still high, and the challenges improvement districts face persist. While some improvement districts are well managed, some are not and struggle with their governance and/or life cycle infrastructure investments (e.g., operations/maintenance, renewal, and upgrades). When improvement districts become dysfunctional or fail to maintain quorum, the drinking water officer lacks the legislative authority or tools to address the failed water system governance. In situations where there may be a gap in representation (i.e., lack of quorum of trustees), the Inspector of Municipalities, under the *Local Government Act*, has the authority to order new elections for the improvement district. If quorum cannot be restored, the matter can be referred to Cabinet to decide whether to appoint a receiver for the system.[10] Of the 190 improvement districts that existed at the end of this reporting period (March 31, 2022), one had failed to maintain a quorum of volunteer trustees to run the system—Lund Waterworks District, which is now in receivership.

The Lund Waterworks District serves approximately 150 connections and is located north of Powell River in the qathet Regional District (qRD).[11] Being in need of substantial infrastructure improvements, the improvement district worked with the qRD to apply for infrastructure grant funding in 2019.[11] The application was unsuccessful. In December 2020, the majority trustees of Lund Waterworks District resigned from the board, which left the water system without quorum.[11]

In 2022, the Province appointed a receiver for the Lund Waterworks District to assume responsibilities of the trustees.[11] According to Vancouver Coastal Health, the receiver is exploring options for funding and determining next steps in transferring ownership of the water system to the regional district.[b,12] The waterworks district has subsequently worked with the qRD on submission of an application for funding improvements to the system; the outcome is pending. In 2022, the receiver requested that a new engineering assessment of the system be conducted to detail the options for, and costs of, improving the water system so that the qRD would be prepared to take ownership of it.[11] The new assessment estimated that it would cost at least $11.9 million to improve the system; however, this estimate may be revised due to cost changes and inflation.[12]

In September 2022, during the development of this report, the Nasookin Improvement District (NID) near Nelson similarly experienced governance challenges and failed to maintain quorum.[13] Following the procedures under the *Local Government Act*, the Inspector of Municipalities called an election to provide NID members an opportunity to elect new trustees to run the system.[14] MUNI and Interior Health met with the Regional District of Central Kootenay and the City of Nelson to explore potential outcomes. Like some other regional districts, the Regional District of Central Kootenay maintains a moratorium on taking over water systems, which limits the local government conversion options for the improvement district.[15] In February 2023, during the development of this report, the election restored quorum for NID; however, the water system continues to be in breach of its order issued under the DWPA to provide potable water to its users (see Section 7.3.3 of this report for more details).[16]

The 2019 PHO drinking water report made a recommendation, "Amalgamation, Acquisition, and Conversion" (Recommendation 10), which specified the following:

a. Develop and resource a strategic approach to encourage and facilitate the conversion of improvement districts, using established best practices.

b. Develop best practices and guidance for local government for the development and implementation of an acquisition and amalgamation plan for small water systems.

c. Identify resources required to develop dedicated funding to a) assist and provide incentive to local governments in the amalgamation or acquisition of small water systems; and b) support the conversion of improvement districts.[1]

An update to this recommendation is provided in Chapter 11 of this report.

[b] To convert (i.e., transfer) ownership of the improvement district to the qRD, the qRD Board of Directors would need to indicate their willingness to take on the service. If willing, the matter would be referred to Cabinet for consideration. If approved, an Order in Council would transfer all assets, obligations, and liabilities of the Lund Waterworks District to qRD, and establish the service. However, if borrowing is needed for the service, the qRD would have seek assent for borrowing from the residents in the newly established service area.

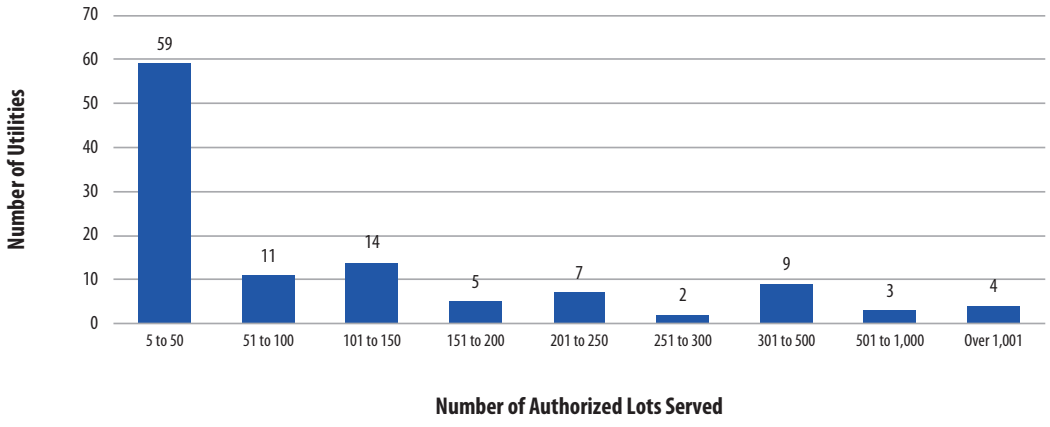
2.2.5 Water Utilities

Developers create utilities as part of a rural land development where community water service is required for subdivision approval. Compared to other non-local government water systems in BC, utilities benefit from financial and administrative oversight and an approval process from the water utility regulation section of FOR prior to incorporation. Prior to construction, utilities must get approval from the Comptroller of Water Rights (the Comptroller) through a Certificate of Public Convenience and Necessity. The certificate describes the conditions under which a utility is developed and outlines how it will operate. The Comptroller does not issue the certificate until the applicant has secured a proven source of water with an adequate supply to meet design needs,[17] provided it has an acceptable engineered design, and has met the required administrative and financial viability conditions. Developers must submit a wide range of financial considerations and documentation in order to prove financial viability.[18,19] The Comptroller also approves water rates for utilities. Water rates are approved on the basis of collecting sufficient revenues to pay for operating costs at a fair and reasonable price.[20]

As of March 31, 2022, FOR had recorded 114 water utilities in the province, two of which were managed by the Comptroller. No new utilities have been created since 2012.[21] The number of utilities has slowly declined in recent years because more utilities have been transferred to local governments than have been created. During the 2017/18–2021/22 fiscal years, seven utilities transferred ownership to local government, and as of June 2022, two other utilities were in the process of potentially transferring to local governments. Typically, this transfer occurs when the owner no longer wishes to operate the system. The transfer may also be the result of poor service quality and/or deterioration of the water system and drinking water quality.

FOR records the size of a utility by the number of authorized lots (i.e., properties) served, not the number of people served. While some utilities can be quite large, as of March 2022, more than half (52 per cent) serviced 50 lots or fewer; only 14 per cent served more than 300 authorized connections (*Figure 2.4*).

Figure 2.4: Number of Private Water Utilities, by Number of Authorized Lots Served, BC, as of March 31, 2022



Source: BC Ministry of Forests, Water Management Branch; 2022.

Unfortunately, the governance structure of utilities sometimes fails, which can leave water systems in a state of disrepair and legal uncertainty. Property owners may create a water users' society under the *Societies Act* to acquire the utility when the original owner/developer no longer wishes to, or is unable to, operate the utility and no local government options are available. The provincial government's preferred form of organization is a local service area, which is normally formed within a regional district to acquire water systems and provide services. However, sometimes the formation of a society is the only option available when the number of connections is too small, or the regional district is unwilling to form a local service area.[22] Some regional districts across BC have implemented moratoriums on the number of small water systems they are willing to acquire, which creates barriers to utilities that wish to transfer ownership of the system to secure access to clean, safe, and reliable drinking water.

The Ministry of Finance's Registrar of Companies may also dissolve a utility after the company or society fails to file required documents or when the director(s) of the company resigns or abandons the water system. When the governing body of a water system dissolves, the company or society that owned and operated it no longer legally exists, and ownership of the system and its assets shifts to the Crown (i.e., the Attorney General of British Columbia). This transfer process occurs under the *Escheat Act*, which requires that the escheated property not be disposed of until two years after its dissolution. If the society or company reforms itself within two years, the property reverts back to the society or company.[23] During the reporting period of 2017/18 to 2021/22, no new utilities fell into escheat. Two previously Crown-seized utilities specified in the 2019 PHO drinking water report were transferred to local governments: Van West Water to the Resort Municipality of Whistler (December 2018) and 753 Waterworks to the District of Hope (February 2020). Two additional Comptroller-managed systems are in the process of transferring to local governments, with resolutions expected within the next two years.

Interior Health reported examples of ongoing challenges with the escheat process during this reporting period. Utilities experience the same challenges that other small water systems face; however, failed utilities face the added challenge of navigating the process of water system amalgamation and/or acquisition by a local government.[24] Amalgamation and/or acquisition is a critical tool for addressing the needs of these community water systems, but current funding mechanisms and legal processes do not facilitate efficient and accountable system handover to governments. The 49 utilities in Interior Health are at different stages of improvement to meet provincial objectives. After many years of work, some of the larger systems (e.g., Anglemont Utilities and Sunnybrae Waterworks) now meet provincial objectives, but others face an uncertain future (e.g., Sage Mesa water supply system).[24]

The 2019 PHO drinking water report made a recommendation, "Utilities and the *Escheat Act*" (Recommendation 11), which specified the following:

> Identify a strategy to ensure that customers of a private water utilities that have fallen into escheat are provided with well-managed, safe, and reliable drinking water as quickly as possible.[1]

An update to this recommendation is provided in Chapter 11 of this report.

2.2.6 Water Users' Communities

Water users' communities (WUCs) are generally quite small and serve rural hamlets or neighbourhoods. Six or more water licensees may form a water users' community.[25] A licensee may be an individual property owner, a mobile home park, a small subdivision, or another type of establishment; therefore, it is difficult to estimate the population size served by the water users' community by tracking the number of licences.

As of March 31, 2022, there were 103 active WUCs in BC.[26] Of those, approximately 99 held domestic water licences for drinking water.[c] Most were located within Interior Health, and there was a high concentration within the West Kootenays and across the Thompson/Okanagan. The number of WUCs in BC has remained relatively constant. Over the past five fiscal years (2017/18–2021/22), no new WUCs were formed, and none were dissolved.

[c] Water users' communities are not limited to domestic use water licence holders. Many of these communities also include licence holders for irrigation use. However, if the licence holders in a water users' community hold only licences for irrigation use and have an alternative water source for domestic use (e.g., a private well), that water users' community would not fall under the *Drinking Water Protection Act*.

Sandy Creek Water Users' Community near Nelson, BC. The intake of Sandy Creek leads to a concrete reservoir. The system supplies 83 connections via gravity but has no treatment, and a long-term boil water notice has remained in place for more than three decades.

Photo credit: Greg Baytalan, Environmental Public Health, Interior Health.

The 2019 PHO drinking water report described in detail the many financial, operational, and administrative challenges that WUCs face. Most WUCs struggle with compliance issues and fail to provide potable water to their users. The Comptroller of Water Rights office provides some ongoing support to water users' communities regarding the *Water Users' Community Act* (WUCA) and *Water Sustainability Act* (WSA), and through letters and the Ministry's website, continues to inform WUCs that they are required to operate in compliance with other legislation that applies to them.[27] Despite these efforts, no concrete actions have been taken to address Recommendations 6 "Regulatory Conflict with the *Water Sustainability Act*" and 12 "Water Users' Communities" from the 2019 PHO drinking water Report, which state the following:

> **Recommendation 6:** Collaborate on policy options to address regulatory conflicts between the *Drinking Water Protection Act* and the *Water Sustainability Act* regarding protecting sensitive aquatic environments under the *Water Sustainability Act* through the construction of joint intake waterworks and preventing the creation of new small water systems under the *Drinking Water Protection Act*.

> **Recommendation 12:** Identify opportunities for greater collaboration on the approval and oversight of water users' communities, in order to improve capacity, accountability, and sustainability.[1]

Mandates and definitions of a water supplier differ among the WSA, WUCA, and DWPA, which continues to perpetuate the creation of unsustainable small water supply systems and significant compliance challenges under the DWPA. The WSA, WUCA, and DWPA were each created for a particular purpose: the WSA was created to manage water resources, the WUCA was created to provide a mechanism for sharing works for the purpose of diverting water, and the DWPA was created to ensure the provision of safe drinking water. Section 2 of the WSA defines the various purposes according to which water may be diverted from a stream or aquifer. The two types of water use purposes defined in the WSA that are most relevant to the DWPA are "domestic purpose"[d] and "waterworks purpose".[e] The DWPA also defines "domestic purposes";[f] however, the definition is slightly different.

[d] Under the WSA section 2, "domestic purpose" means the use of water for household purposes by the occupants of, subject to the regulations, one or more private dwellings other than multi-family apartment buildings, including, without limitation, hotels and strata titled or cooperative buildings, located on a single parcel, including, without limitation, the following uses: (a) drinking water, food preparation, and sanitation; (b) fire prevention; (c) providing water to animals or poultry kept (i) for household use, or (ii) as pets; (d) irrigation of a garden not exceeding 1,000 m2 that is adjoining and occupied with a dwelling.

[e] Under the WSA section 2, "waterworks purpose" means the carriage or supply of water by one person or entity for the use in British Columbia of another person or entity.

[f] Under the DWPA, "domestic purposes" means the use of water for (a) human consumption, food preparation, or sanitation, (b) household purposes not covered by paragraph (a), or (c) other prescribed purposes.

Under the DWPA, a water supplier is the owner of a water supply system. A water supply system is any domestic water system that serves anything other than a single-family residence. Under the DWPA, a domestic water system includes all works used to obtain intake water; equipment, works, and facilities for water treatment, diversion, storage, pumping, transmission, and distribution; and any other equipment, works, or facilities prescribed as being regulated. On the basis of the definitions of a water supplier and water supply system in the DWPA, both WUCs and "good neighbour systems"[9] (i.e., domestic water users who share works either through a joint works agreement [see text box below] or an informal arrangement) operate water supply systems, and the WUC or the licence holders of the joint works are the water supplier/joint owners of the system.

By way of contrast, FOR's Water Management Branch, which administers the WUCA and water licensing under the WSA, does not view WUCs or licensees that have a joint works agreement for domestic use as water suppliers because under FOR's legislation, the reason for creating a WUC or a joint works agreement or arrangement is not to create a water purveyor or "waterworks purpose", but rather to provide a legal structure to maintain and share works for ecological and conservation purposes. These different interpretations of who is a water supplier and what is a waterworks purpose exacerbate chronic compliance challenges that drinking water officers routinely face with WUCs and good neighbour water systems that have joint works, who often do not view themselves as water supply systems under the DWPA.

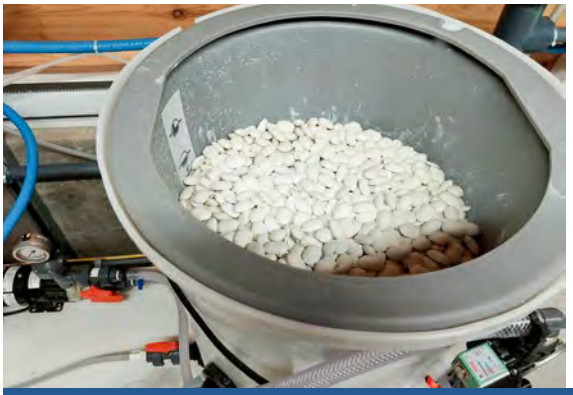
As a result of this disconnect in interpretations in legislation regarding what constitutes a water supplier when sharing works, the construction of works for managing the diversion, storage, and use of water for domestic use may be authorized without reference in the WSA or WUCA to the requirement for a construction permit under the DWPA. These authorizations of joint works under a water license create small water supply systems under the DWPA when the water is used for domestic purposes. Authorization of joint works under the WSA without reference to the DWPA poses a risk that the joint works will be constructed without approvals from a drinking water officer, which potentially places consumers at risk of consuming unsafe drinking water. Similarly, section 52 of WUCA references the right of a WUC to construct works for water used for domestic purposes without reference to the DWPA. Although the requirement for a construction and operating permit is not referenced in the WSA or WUCA, FOR provides, in a cover letter to licensee applicants, advice to secure any other required permissions, such as those under the DWPA.

An update to Recommendations 6 and 12 is provided in Chapter 11 of this report.

Joint Works Agreements

A joint works agreement is a legal agreement that describes how responsibilities and costs will be shared among two or more applicants or authorization holders for the construction and maintenance of works that are, or are proposed to be, jointly used under a water licence or use approval under the *Water Sustainability Act* (WSA). There are two avenues for developing a joint works agreement: parties voluntarily agree to share works jointly in a manner consistent with their authorizations, or parties may be ordered to jointly construct and use works under section 36 of the WSA where the water manager concludes it would provide ecological benefit. The purpose of a joint works agreement is not to ensure water quality.

[9] Drinking water officials refer to domestic water license holders who share works either with or without a joint works agreement (but not incorporated as a WUC) as "good neighbour systems", as defined in Table 2.3.



BC Parks operates many water systems across BC, which are categorized in this report as stand-alone publicly owned recreational facilities. Syringa Provincial Park has a small water system on the southeast end of Arrow Lake north of Castlegar, which provides drinking water to the park's campsite from a groundwater well that is at risk of containing viral pathogens. The system recently upgraded its drinking water treatment plant for the park (top), which includes pellet feed chlorination (bottom left). The treated groundwater is stored in a reservoir under a sun shade (bottom right).

Photo credit: Greg Baytalan, Environmental Public Health, Interior Health.

2.2.7 Stand-alone Facility Water Systems

For the first time, the PHO is able to report on the number of stand-alone facilities, which include water systems that supply industrial/commercial, recreational, public health, schools, and other facilities, because of gradual improvements in data collection at the regional health authorities. *Table 2.10* shows the number of stand-alone facility water systems by regional health authority as of March 31, 2022. Sixty-three per cent of BC's water supply systems (3,115 water systems) serve stand-alone facilities. Privately owned recreational facilities and public health food facilities comprise more than 50 per cent of the various system types. Work camps and work sites are located predominantly within Northern Health, owing to the high number of industrial activities in that region. In terms of water system types overall, most were associated with recreational facilities, followed by public health facilities, industrial/commercial facilities, and schools and other facilities (*Figure 2.5*). In some cases, regional health authorities were able to report only by the base water system type rather than sub-type because data systems are still being altered to track those system types. These data will be expanded upon in future PHO reports.

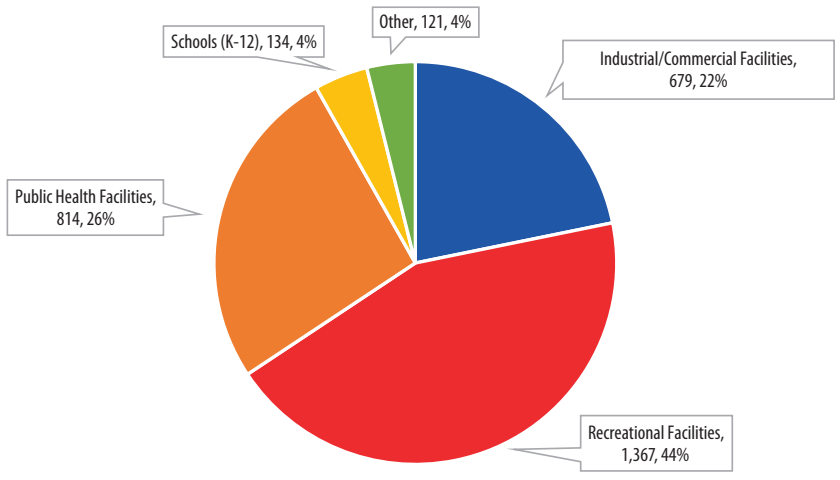
Table 2.10: Number of Stand-alone Facility Water Systems by Regional Health Authority, BC, as of March 31, 2022

Water System Type	Water System Sub-type	Island Health	Northern Health	Vancouver Coastal Health	Interior Health	Fraser Health
Industrial/ Commercial Facilities	Work Camps	7	218	3	39	7
	Work Sites	92	161	27	92	33
Recreational Facilities	Publicly Owned	35	282	18	54	43
	Privately Owned	172		82	607	74
Public Health Facilities	Food Facilities	215	112	28	343	70
	Licensed Community Care & Health Care Facilities	27	3	3	2	11
Schools (K-12)	Public Schools	20	45	8	33	12
	Independent Schools	9		1	2	4
Other	Civic & Community Facilities/ Institutions	67	0	7	20	27

Note: Detailed definitions of stand-alone facility water systems are provided in Table 2.4. Where regional health authority data systems did not record individual sub-types, combined totals were provided instead.

Source: Regional health authorities; 2021/22.

Figure 2.5: Number of Stand-alone Facility Water Systems, BC, as of March 31, 2022



Source: Regional health authorities; 2021/22.

2.3 Water Systems in BC First Nations Communities

In BC, First Nations drinking water systems on reserve are categorized and defined differently than water supplies found off reserve. *Table 2.11* describes the categories used by Indigenous Services Canada and First Nations Health Authority (FNHA).

The enactment of the *Indian Act* created 203 First Nations in British Columbia. Of these, 197 First Nations have many on-reserve water systems. Community water systems consist of five or more connections, public water systems have fewer than five connections but include one or more public facility connections, micro water systems have two to four connections, and individual water systems are single connections (*Table 2.11*).[28] As shown in *Figure 2.6*, the most common water system types on-reserve are individual water systems, followed by community water systems.

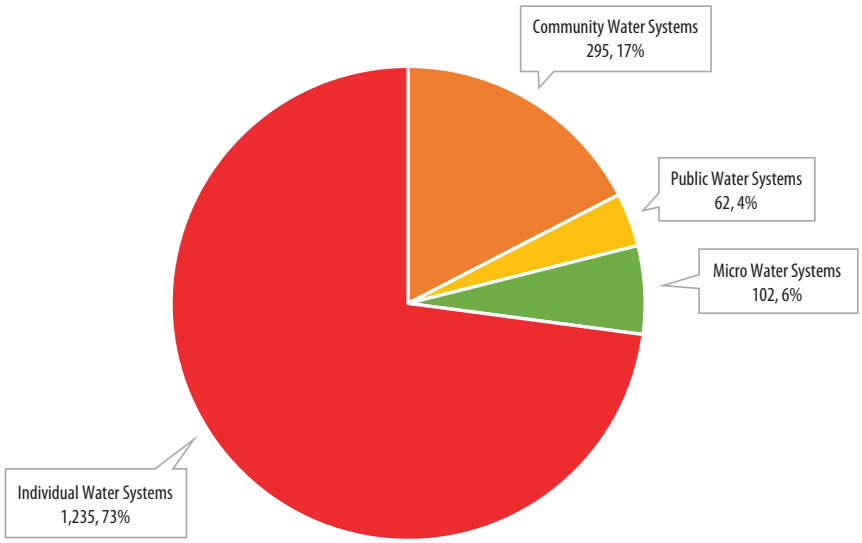
On October 1, 2013, FNHA took over responsibility from Health Canada for delivering Environmental Public Health Services on BC First Nations reserve lands, which includes addressing public health concerns related to drinking water on reserve. Through the Drinking Water Safety Program, FNHA works in partnership with First Nations communities to support access to safe and

Table 2.11: Categories of First Nations Drinking Water Systems, BC

Category	Description
Community Water Systems	Community system with five or more connections.
Public Water Systems	Water supply system with fewer than five connections but includes one or more public facilities.
Micro Water Systems	Water system with two to four connections; no public facilities.
Individual Water Systems	Private well or surface intake serving a single private connection.

Source: First Nations Health Authority; 2022.

Figure 2.6: Number of First Nations Drinking Water Systems, BC, as of March 31, 2022



Note: Single connections that serve a single-family dwelling off reserve would not fall under the purview of the *Drinking Water Protection Act* or the regional health authorities.

Source: First Nations Health Authority; 2021/22.

reliable drinking water within their communities. The Drinking Water Safety Program, which adheres to the *Guidelines for Canadian Drinking Water Quality*,[29] is a core part of Environmental Public Health Services that identifies, prevents, and works to mitigate public health risks in First Nations communities.[28]

The objectives of the program are to maintain the quality of drinking water by conducting sampling and testing activities in distribution systems of community water systems, to reduce public health risks associated with potential water contamination, to advise communities on how to address potential public health concerns, and to build the capacity of First Nations through community-based water monitoring.[28]

Environmental health officers from FNHA are assigned to First Nations communities to support activities under the Drinking Water Safety Program. FNHA also has four regional environmental health technicians who support the program. FNHA staff use the provincial regulations and guidelines as guidance to support communities in meeting or exceeding provincial standards on reserve.[28]

FNHA environmental health officers work with water treatment plant operators and community-based water monitors to develop sampling plans, as recommended by provincial and federal regulations, guidelines, and best practices, that are representative of the distribution system. Community sampling programs are developed to be specific to the type, size, and complexity of the water system.[28]

Community-based water monitors play a key role in the Drinking Water Safety Program because they are responsible for sampling, testing, recording, and communicating the microbiological quality of treated water within the community. In communities that do not have a monitor, the environmental health officer or environmental health technicians will conduct the sampling. Staff of the Drinking Water Safety Program train community-based water monitors on sampling and testing drinking water for potential bacteriological contamination using in-community laboratory equipment (Colilert®). The community laboratory equipment and any additional sampling conducted at approved laboratories are funded through the Drinking Water Safety Program. Regular sampling of chemicals in drinking water is also conducted in community water systems depending on raw water quality and the type of treatment installed.[28]

Craig Casimel, a certified water operator from Stellat'en First Nation, provides an overview of the community's Stellaquo Water Treatment Plant to Joey Cheng, an environmental health officer from the First Nations Health Authority. The treatment for the ground water supply includes chlorination and filtration for manganese and arsenic. The water system provides water that meets both the *Drinking Water Treatment Objectives (Micro-biological) for Ground Water Supplies in British Columbia* and the *Guidelines for Canadian Drinking Water Quality.*

Photo credit: First Nations Health Authority.

Indigenous Services Canada is responsible for providing funding for drinking water infrastructure and for building First Nations capacity to operate, monitor, and maintain drinking water and wastewater systems. Since 2016, the Government of Canada has committed $5.6 billion of targeted funds until 2023–2024 to build, repair, manage, and maintain water and wastewater systems on reserve. This includes $1.043 billion through Budget 2021 to support water and wastewater projects. Budget 2022 committed $398 million to support infrastructure, with at least $247 million for water and wastewater to continue addressing long-term drinking water advisories and preventing new ones.[30]

Since 2017, Indigenous Services Canada has gradually been transferring the care and control of water and wastewater services to First Nation-led organizations; this includes the development, provision, assessment, and improvement of programs and services to support clean water.[31]

Indigenous Services Canada also supports operation of community water systems on reserve through the Circuit Rider Training Program, which is designed to assist water treatment plant operators with water system operation and troubleshooting when technical issues arise.[28]

On December 22, 2021, courts approved the settlement between Canada and certain First Nations and their members who were subject to a drinking water advisory that lasted at least one year between November 20, 1995 and June 20, 2021. The settlement includes compensation for impacted First Nations and eligible individuals, and commitments to fund the construction, operation, and maintenance of infrastructure needed to provide regular access to safe drinking water in their homes.[32]

Rod Sam, a certified water operator from Ahousaht First Nation, and Scott Jameson, a certified water and wastewater operator and Circuit Rider, inspecting the flocculation tanks and working together to install a new mixing system at the Ahousaht Water Treatment Plant.

Photo credit: Kalpna Solanki, Environmental Operator Certification Program President and CEO.

Update on Funding from Indigenous Services Canada

As of March 31, 2023, during the development of this report, more than $3.45 billion of targeted funding had been invested to support 1,206 water and wastewater projects in First Nations communities across Canada, of which 530 have been completed and 676 are ongoing. These projects will serve 472,000 people in 593 First Nations communities. In BC, $362.9 million has been invested to support 187 water and wastewater projects, 58 of which have been completed. These projects will serve 53,000 people in 184 First Nations communities.[30]

Acknowledgement of Indigenous Inherent Rights

Indigenous inherent rights, rooted in connection to lands and waters, have never been ceded or surrendered. Settler colonial laws, policies, and practices have created enduring obstacles for BC First Nations in fully exercising their rights in relation to their waters, which are a primary and sacred source of health and wellness. The Provincial Health Officer (PHO) is grateful to the First Nations Health Authority for sharing insights into the status of water systems in BC First Nations communities. The PHO recognizes that much more work needs to be done to uphold inherent rights and adopt co-governance models that embody a more wholistic understanding of water than simply the technical aspects of service delivery and drinking water monitoring, and the topic of drinking water in First Nations communities is much larger than this report can cover. The PHO strives to continually improve reporting on health issues in true partnership with First Nations, Métis, and Inuit Peoples.

REFERENCES

[1] BC Office of the Provincial Health Officer. Clean, safe, and reliable drinking water: an update on drinking water protection in BC and the action plan for safe drinking water in British Columbia 2019 [Internet]. Victoria, BC: BC Office of the Provincial Health Officer; 2019 [cited 2021 Nov 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/pho-drinking-water-report-2019.pdf*.

[2] Government of British Columbia. Improvement districts boundary changes and dissolutions [Internet]. Victoria, BC: Government of British Columbia; [cited 2022 Aug 17]. Available from: *https://www2.gov.bc.ca/gov/content/governments/local-governments/improvement-districts-governance-bodies/improvement-districts/boundaries*.

[3] Bedford, B. Personal communication. BC Ministry of Municipal Affairs; 2022 Feb 18.

[4] Lynch, K. Personal communication. BC Ministry of Municipal Affairs; 2023 Feb 17.

[5] BC Ministry of Community Services. Improvement district governance: policy statement [Internet]. Victoria, BC: BC Ministry of Community Services; 2006 [cited 2022 Apr 22]. Available from: *https://www2.gov.bc.ca/assets/gov/british-columbians-our-governments/local-governments/governance-powers/improvement_district_governance_policy.pdf*.

[6] BC Ministry of Municipal Affairs. Response to request for updates to activities in support of the Provincial Drinking Water Officer report for 2017/18–2020/21 [email from B Bedford]; 2022 May 16.

[7] Kelowna Capital News. South East Kelowna Irrigation District dissolved [Internet]; [cited 2023 Oct 18]. Available from: *https://www.kelownacapnews.com/news/south-east-kelowna-irrigation-district-dissolved-3164134*.

[8] Madelaine, M. Personal communication. BC Ministry of Municipal Affairs; 2023 Oct 31.

[9] Norlin, I. Personal communication. Interior Health; 2023 Oct 27.

[10] Local Government Act [statute on the Internet]; [cited 2023 Feb 15]. Available from: *https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/r15001_00*.

[11] qathet Regional District. Lund Waterworks District [Internet]. Powell River, BC: qathet Regional District; [cited 2023 Feb 15]. Available from: *https://www.qathet.ca/current_project/lund-waterworks-district/*.

[12] Vancouver Coastal Health Authority. [email from J Davidson]; 2022 Nov 9.

[13] Interior Health Authority. NID compliance status update October 7th 2022 [Letter from I Norlin]; 2022 Oct 7.

[14] BC Ministry of Municipal Affairs. [Letter from BC Ministry of Municipal Affairs to Nasookin Improvement District (271361)]; 2022 Oct 26.

[15] Dr. Mema, S. Personal communication. Interior Health Authority; 2022 Oct 20.

[16] Kolb, S. Personal communication. BC Ministry of Municipal Affairs; 2023 Feb 3.

[17] BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Design guidelines for rural residential community water systems [Internet]. Victoria, BC: BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development; 2012 [cited 2022 Jun 14]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-licensing-and-rights/water-utilities/design_guidelines_rural_residential_water_mar2012.pdf*.

[18] BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Guide to applying for a Certificate of Public Convenience and Necessity (CPCN) [Internet]. Victoria, BC: BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development; 2022 Mar [cited 2022 Jun 14]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-licensing-and-rights/water-utilities/application_guide_certificate_of_public_convenience.pdf*.

[19] BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Financial guidelines for Certificate of Public Convenience and Necessity (CPCN) applications [Internet]. Victoria, BC: BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development; 2016 Nov [cited 2022 Jun 14]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-licensing-and-rights/water-utilities/cpcn_appen1_cpcn_financial_guidelines.pdf*.

[20] Government of British Columbia. Water utilities application process [Internet]. Victoria, BC: Government of British Columbia; [cited 2022 Jun 08]. Available from: *https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-licensing-rights/private-water-utilities/water-utilities-application-process*.

[21] McMillan, C. Personal Communication. BC Ministry of Forests; 2023 Feb 16.

[22] Government of British Columbia. Forming a society [Internet]. Victoria, BC: Government of British Columbia; [cited 2022 May 06]. Available from: *https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-licensing-rights/private-water-utilities/water-utilities-information-bulletins/forming-a-society*.

[23] Escheat Act [RSBC 1996, c.120] [statute on the Internet]; [cited 2022 May 06]. Available from: *https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96120_01*.

[24] Interior Health Authority. Response to request for data in support of the PHO report [email from I Norlin]; 2022 Dec 05.

[25] Government of British Columbia. Water users' communities [Internet]. Victoria, BC: Government of British Columbia; [cited 2022 May 27]. Available from: *https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-licensing-rights/water-users-communities*.

[26] BC Ministry of Forests. Response to request for Water Users' Communities data in support of PHO report [email from S Mlinar]; 2023 Mar 30.

[27] BC Ministry of Forests. Response to request for data in support of the PHO report [email from C Chapman]; 2022 Aug 02.

[28] First Nations Health Authority. Response to request for updates to the status of drinking water in British Columbia [email from R Fleming]; 2022 Sep 28.

[29] Health Canada. Canadian drinking water guidelines [Internet]. Ottawa, ON: Health Canada; 2018 Aug 24 [cited 2022 Jun 02]. Available from: *http://hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/guide/index-eng.php*.

[30] Molyneux, T. Personal communication. Indigenous Services Canada. 2023 Jul 11.

[31] Indigenous Services Canada. Supporting First Nations control of water delivery [Internet]. Ottawa, ON: Government of Canada; [cited 2023 Jul 17]. Available from: *https://www.sac-isc.gc.ca/eng/1614386222674/1614386243479*.

[32] Indigenous Services Canada. Water in First Nations communities [Internet]. Ottawa, ON: Government of Canada; [cited 2023 Jul 17]. Available from: *https://www.sac-isc.gc.ca/eng/1100100034879/1521124927588*.

Source water protection is the first line of defense in the multi-barrier approach to safe drinking water, followed by robust treatment and distribution integrity. The Rose Valley Lake reservoir (above) supplies drinking water to communities in West Kelowna. The reservoir is a multi-use watershed that has been challenged by many different water quality threats, such as algae blooms, phosphorous loading, and wildfire. The City's new $75 million Rose Valley Water Treatment Plant will provide additional layers of protection to help manage future impacts from algae and climate change.

Photo credit: City of West Kelowna.

PART 2:

The Multi-barrier Approach – Key Elements

Part 2 presents the key components of the multi-barrier approach to providing clean, safe, and reliable drinking water in BC. It covers guidelines and activities carried out under the *Drinking Water Protection Act* that pertain to the three core components of this approach: source water protection (Chapter 3), drinking water treatment (Chapter 4), and distribution system integrity (Chapter 4).

CHAPTER

3

Source Water Protection

Source protection is the first line of defense in the multi-barrier approach to safe drinking water. This component of the multi-barrier approach includes selecting the best available water source and protecting it from contamination. Source water can be surface water from lakes, streams, and springs, or groundwater. Preventing contamination from reaching the source of drinking water is the first key step in reducing public health risks.[1] Prevention of contamination can also reduce capital and operating costs by reducing treatment demand or the need for extra treatment barriers. This chapter covers source protection tools such as source assessments, drinking water protection plans, and assessments for groundwater at risk of containing pathogens.

3.1 Source Assessments and Protection Plans

The *Action Plan for Safe Drinking Water in British Columbia* (the Action Plan) calls for all water systems to be thoroughly assessed from source to tap to determine risks, starting with those that may pose the highest risks to users.[2] A key element of this includes an assessment of the source water, which includes identifying and assessing hazards within a water supply system watershed or aquifer capture zone.

Sections 18 and 22 of the *Drinking Water Protection Act* (DWPA) support assessments and provide drinking water officers (DWOs) with the authority to order a water supplier to complete a source or system assessment (section 18) and

The Sooke Lake Reservoir is within a protected watershed and is the primary water source for the Capital Region District.

Photo credit: Capital Regional District, 2022.

prepare a response plan (section 22) to address any identified risks. DWOs may also make the completion of an assessment and plan a requirement through a water supplier's operating permit (section 8(2)).[3]

The new indicator project led by the Provincial Health Officer (PHO) identified the completion of source water assessments and the development and implementation of source protection plans as source protection indicators for future reporting. Regional health authorities were able to provide a limited set of data for the 2019/20 fiscal year (*Table 3.1*) and are working to adapt their information systems to enhance their ability to collect this information. Additionally, the information in *Table 3.1* is limited specifically to local government systems that serve more than 500 people per day, inclusive of municipalities, regional districts, and improvement districts.

Based on the data in *Table 3.1*, most source assessments and source protection plans have been undertaken by municipalities, and by regional districts to a lesser extent. These systems likely serve larger population centres, and have financial and staff resources and expertise to conduct these complex assessments. *Table 3.2* shows the data collected for the 2021/22 fiscal year, which include some data from regional health authorities on community water system, only by system size. Those data indicate that more large water systems (65 per cent) completed source assessments than did small water systems (17 per cent). This is also the case for response plans and their implementation; however, the data are still lacking for those source water protection indicators. Future PHO reports aim to further evaluate the number of assessments and protection plans in use in BC.

Because the data in *Tables 3.1* and *3.2* are limited, they do not accurately capture the true extent of source and system assessments that have been completed for water systems. However, the regional health authorities provided the following additional qualitative information in response to Recommendation 13 from the 2019 PHO drinking water report.

Table 3.1: Number of Source Assessments and Source Protection Plans for Large Local Government Systems as of March 31, 2020

Regional Health Authority	Indicator: Source Protection	Local Government Water Systems Serving >500 People/Day		
		Municipality	Regional Districts	Improvement Districts
Vancouver Coastal Health	Number of systems in each category with an accepted source assessment on file*	6	3	0
	Number of systems with a completed source protection/assessment response plan	2	1	0
	Number of water systems that have implemented their source protection plans	2	1	0
Interior Health	Number of systems in each category with an accepted source assessment on file*	16	7	4
	Number of systems with a completed source protection/assessment response plan	13	5	0
	Number of water systems that have implemented their source protection plans	11	6	1

Note: As of March 31, 2020, only Vancouver Coastal Health and Interior Health were able to report any data on source assessments and protection plans. *The type of assessment reported is unknown (i.e., whether the assessment followed the *Comprehensive Drinking Water Source-to-Tap Assessment Guideline* or whether the assessment refers to completion of the *Drinking Water Source-to-Tap Screening Tool*). Data for 2020/21 were not requested from all regional health authorities due to data system limitations or resource limitations as a result of the COVID-19 pandemic response.

Source: Regional health authorities; 2020.

Interior Health guides all large water systems to complete comprehensive assessments (i.e., equivalent to the BC *Comprehensive Drinking Water Source-to-Tap Assessment Guideline*).[4] In April 2022, Interior Health reported that 47 large community water systems in the health authority had completed source water assessments.[4] Interior Health also works with partner agencies and communities to ensure water suppliers are included as key interested parties in the management of watersheds.[4] A simplified process is followed for small and stand-alone systems (i.e., equivalent to the *Drinking Water Source-to-Tap Screening Tool*), which builds from a source evaluation as the first step in the system permitting process.[4]

Fraser Health requires all small water systems in its region to complete the *Drinking Water Source-to-Tap Screening Tool*.[5] Vancouver Coastal Health outlines drinking water system risks and vulnerabilities in a facility's inspection or assessment report.[6] In situations where groundwater sources warranted further evaluation, the Ministry of Health's (HLTH's) *Guidance Document for Determining Ground Water at Risk of Containing Pathogens (GARP)* is used by DWOs or third-party specialists that are hired by the water system operator.[6]

Island Health indicated that it will develop a work plan to conduct an inventory of system and source assessments.[7] The plan will include contacting water systems that have not completed assessments, and requiring them to do so within an agreed-upon time frame.[7] Completion of the inventory will become a part of Island Health's process for creating new water systems.[7] However, Island Health indicated that it will need additional drinking water program staff to determine which water systems require a source assessment, and to create and update an assessment tracking system.[7]

In Northern Health, source and system assessments are conducted as part of the construction permitting process.[8] In 2019, Northern Health also added source assessments as a requirement to its source water approval process.[8]

Table 3.2: Number of Accepted Source Assessments and Completed and Implemented Source Protection Plans for Community Water Systems, by System Size, as of March 31, 2022

Regional Health Authority	Water System Size	Number of Community Water Systems	Number of Systems with an Accepted Source Assessment on File*	Number of Systems with a Completed Source Protection/Assessment Response Plan	Number of Water Systems that Have Implemented their Source Protection Plans
Island Health	Small	715	149	–	–
	Large	60	52	–	–
Northern Health	Small	174	50	60	–
	Large	34	12	9	–
Vancouver Coastal Health	Small	160	20	–	–
	Large	28	16	–	–
Interior Health	Small	263	4	3	2
	Large	72	47	36	33
Total	**Small**	**1,312**	**223**	**–**	**–**
	Large	**194**	**127**	**–**	**–**

Note: Island Heath, Vancouver Coastal Health, and Northern Health data systems did not fully capture this information at this time. *The type of assessment reported is unknown (i.e., whether the assessment followed the *Comprehensive Drinking Water Source-to-Tap Assessment Guideline* or whether the assessment refers to completion of the *Drinking Water Source-to-Tap Screening Tool*). Data were not available from Fraser Health due to data system limitations.

Source: Regional health authorities; 2022.

3.2 Drinking Water Protection Plans

A drinking water protection plan (DWPP) is a legislative source protection tool that may provide special powers to local authorities to regulate activities in areas of concern for a community water supply system. Part 5 of the DWPA outlines the requirements for designating an area for a DWPP, the plan authority, and the planning and implementation process.[3] However, the Minister is responsible for deciding whether to initiate a DWPP. Under section 31 of the DWPA, the PHO may make a recommendation to the Minister to designate an area by order for the purpose of developing a DWPP for the area. The PHO may make such a recommendation only if the following requirements under the Act are satisfied:

(a) based on monitoring or assessment results, the Provincial Health Officer is satisfied that a drinking water protection plan will assist in addressing or preventing a threat to drinking water that the Provincial Health Officer considers may result in a drinking water health hazard, and

(b) no other practical measures available under this Act are sufficient to address or prevent the drinking water hazard.[3]

A DWO may make a request to the PHO to consider making a recommendation to the Minister if they can demonstrate the above criteria have been met. In addition, a local authority or a water supplier may ask a DWO to make a request to the PHO on their behalf.

To date, no DWPPs have been ordered by the Minister of Health in BC; however, on four separate occasions (2008, 2010, 2015, and 2018), the PHO recommended that a DWPP be developed for the Comox Lake watershed. Although the Minister has not ordered the development of a DWPP for the watershed as a result of the PHO's past recommendations, the threats to public health from drinking water from the Comox Valley Regional District water system have been reduced since our last report, as described in the text box below.

Comox Valley Water Treatment Project

The new Comox Valley Regional District water treatment facility, completed in September 2021, was built to address previous deficiencies in meeting surface water treatment objectives because the Comox valley has had a history of turbidity-related boil water notices.[9]

The facility includes a new lake intake, a new lake shore pump station, new transmission mains, and a new treatment plant, and it provides three treatment processes: filtration, ultraviolet treatment, and chlorination.[9]

The new facility will eliminate the need for turbidity-related boil water notices and the risk of viruses and bacteria in drinking water, but the multi-barrier approach to safe drinking water starts with source protection. The Comox Lake watershed will still be subject to source water quality issues, which can be compounded by episodic rainfall events. As such, the need for an effective source protection plan for the watershed remains.

(Top) Outside the newly constructed Comox Valley Regional District (CVRD) water treatment facility. (Left) Inside the CVRD water treatment facility—flocculation tanks. (Right) Inside the CVRD water treatment facility.

Photo credits: Comox Valley Regional District.

3.2.1 Review of Drinking Water Protection Plans

In 2019, the Office of the Auditor General (OAG) recommended that the PHO collaborate with HLTH to review legislative provisions regarding DWPPs and report on impediments to implementation of those plans.[10] Similar to the OAG report, the 2019 PHO drinking water report recommended that the respective responsible government ministries conduct a review of the legislated tools under various statutes to protect source water (PHO Recommendations 4 & 5). This included a review of the DWPA and source protection tools such as DWPPs.[11]

HLTH, the Ministry of Water, Land and Resource Stewardship (WLRS), and the PHO are working in collaboration to review any impediments to recommending, developing, and implementing DWPPs, and are assessing similar planning processes under other legislation, such as the *Water Sustainability Act*, and other community-based planning measures to develop potential amendments to the legislation for consideration. In 2021, a PHO and HLTH team conducted research on the use and purpose of DWPPs, which aimed to follow up on the actions planned and submitted to the select standing committee on public health accounts in 2019 in response to the OAG recommendation pertaining to DWPPs.[12,13] The research team identified five themes regarding common impediments to using DWPPs, as of 2021:

- The legal test for DWPPs is ambiguous and onerous and is subject to potential competing interests.
- The language in the DWPA impedes the utility of DWPPs as a proactive public health tool.
- Decision makers at all levels do not have guidance on what criteria must be met to trigger a DWPP.
- The Province does not have accountable leadership regarding source water protection.
- There are no established funding mechanisms for DWPPs.[12]

The research team concluded that DWPPs could play an important role in source water protection planning in BC; however, they need to be accompanied by an alignment of watershed planning initiatives across government and a coherent strategy for source water protection across the province.[12] The creation of WLRS in 2022 addresses the source water protection accountability framework concerns identified by the research team.

WLRS has the mandate to "provide Provincial leadership on water policy and strategies, including the coordination of government's Source to Tap Strategy to protect drinking water."[14]

A review of regulatory tools for protecting water sources, including DWPPs, will be part of this work. The Watershed Security Strategy is another important strategy being led by WLRS that has linkages to the Source-to-Tap Strategy.[15]

3.3 Groundwater at Risk of Containing Pathogens

Section 6 of the DWPA states that a water supplier must provide drinking water from its water supply system that:

(a) is potable water, and

(b) meets any additional requirements established by the regulations or by its operating permit.[3]

In addition, section 5(2) of the Drinking Water Protection Regulation states that:

> For the purposes of section 6(b) of the Act, drinking water from a water supply system must be disinfected by a water supplier if the water originates from
>
> **(a)** surface water, or
>
> **(b)** groundwater that, in the opinion of a drinking water officer, is at risk of containing pathogens.[17]

Watershed Security Strategy

The Province has committed to developing a Watershed Security Strategy (WSS) with First Nations and in collaboration with local and federal governments. Industry and environmental non-governmental organizations will also provide input into the development of the WSS. Key points of the WSS include the following:

- There is a need to build on and align with work across government to help ensure BC's watersheds are healthy.
- The WSS must reflect the Province's commitment to true, lasting reconciliation and must align with the United Nations Declaration on the Rights of Indigenous Peoples and the *Declaration on the Rights of Indigenous Peoples Act*, 2019.
- Key policy directions such as governance, climate change, ecosystems, drinking water, community and economic stability, and education and knowledge should be explored.
- Consultation should be conducted across government to ensure that the WSS is aligned with other priorities, such as the coastal, salmon, and drinking water strategies, and modernized land use planning.[15]

During the development of this report, the BC government invested $100 million into the launch of a Watershed Security Fund. In March 2023, this money was transferred to the Real Estate Foundation of BC, which will co-develop the Fund with First Nations (the Province will play an advisory role). The Watershed Security Fund will be just one of several tools and resources to support implementation of actions identified in the WSS.

WLRS and the First Nations Fisheries Council also convened the BC-First Nations Water Table to support the Province and First Nations in identifying, discussing, and making consensus-based recommendations to provincial and First Nations' decision makers about matters of mutual interest. The first priority of the Water Table is to co-develop the WSS.[16]

For more information on the WSS, see Chapter 11 of this report.

A shallow, dug well—an example of groundwater at risk of containing pathogens.
Photo credit: Philip Jackson, Nelson, BC.

The DWO is responsible for identifying whether a groundwater source is at risk of containing pathogens after conducting a Groundwater at Risk of Containing Pathogens (GARP) assessment.[18] The drinking water from a water supply system must then be disinfected as per section 5(2) of the Drinking Water Protection Regulation.[17] GARP is defined as any groundwater supply that is likely to be contaminated from any source of pathogens, continuously or intermittently. Potential sources of pathogens may include wildlife, sewage discharged to land, leaking municipal sewage pipes, agricultural waste stockpiles, runoff intrusion into uncovered or poorly constructed wells, and contaminated surface water.

The 2017 *Guidance Document for Determining Groundwater at Risk of Containing Pathogens (GARP) Version 3*[18] outlines the results of a GARP determination as follows:

- At risk of containing pathogens (GARP): If one or more identified hazards pose an obvious risk of pathogenic contamination of a ground water source, the source would be determined to be "at risk" or GARP.
- If the DWO has reason to believe that the source is at risk of containing only viruses, the source would be determined to be "GARP-viruses only."
- At low risk of containing pathogens (Non-GARP): Where no hazards are present, or they have all been confirmed as low risk, the ground water source would be determined to be "at low risk" of being GARP.[18]

The procedure outlined in the guidance document follows a staged approach from initial screening and assessment to the determination of GARP, review of risk mitigation options, and long-term monitoring. DWOs may determine risk to a groundwater source at any of these four

stages of the process. Determining whether a groundwater source is GARP is not regarded as a one-time process but is subject to the results of continued long-term monitoring of the water supply system, conditions of the aquifer, well capture zone, and watershed over time.

Table 3.3 shows the number of GARP assessments, by regional health authority, as of March 31, 2022. Regional health authorities have largely adapted their data systems to track this information. However, the totals presented in *Table 3.3* do not completely correlate to the groundwater source totals from *Table 2.6* due to some systems having multiple groundwater water sources or as a result of multiple assessments having been completed.

Across the regional health authorities, 14 per cent of water supply system groundwater sources were determined to be at risk of containing pathogens, and 2 per cent of groundwater sources were at risk of containing viruses only. Of the GARP assessments completed, 20 per cent were determined to be at low risk. Unfortunately, there remains a large number (64 per cent) of unassessed groundwater sources, which is a concern because there is potential for these sources to be or become contaminated.

Table 3.3: Number of Groundwater at Risk of Containing Pathogens (GARP) Assessments, by Regional Health Authority, BC, March 31, 2022

Regional Health Authority	GARP	GARP-Viruses Only	Non GARP (Low Risk)	Not Assessed/ Unknown
Island Health	72	28	77	587
Northern Health	36	3	115	896
Vancouver Coastal Health	83	0	117	49
Interior Health	282	42	226	692
Fraser Health	42	2	196	128
Total	**515**	**75**	**731**	**2,352**

Source: Regional health authorities; 2022.

REFERENCES

[1] Canadian Council of Ministers of the Environment. From source to tap: guidance on the multiple-barrier approach to safe drinking water. [Internet]. Winnipeg MB: Federal-Provincial-Territorial Committee on Drinking Water and the CCME Water Quality Task Group; 2004 [cited 2022 Jun 14]. Available from: *https://ccme.ca/en/res/sourcetotap-finalenglish03-28-04.pdf*.

[2] BC Ministry of Health Planning, BC Ministry of Health Services. Action plan for safe drinking water in British Columbia. [Internet]. Victoria, BC: BC Ministry of Health Planning, BC Ministry of Health Services; 2002 [cited 2022 Apr 25]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/safe_drinking_printcopy.pdf*.

[3] *Drinking Water Protection Act* [SBC 2001, c.9] [statute on the Internet]; [cited 2022 Apr 25]. Available from: *http://www.bclaws.ca/civix/document/id/complete/statreg/01009_01*.

[4] Interior Health Authority. Response to request for data in support of the PHO report [email from S Pollock]; 2022 Apr 21.

[5] Fraser Health Authority. Response to request for data in support of the PHO report [email from B Choquette]; 2022 Apr 19.

[6] Vancouver Coastal Health Authority. Response to request for data in support of the PHO report [email from M Ritson]; 2022 Apr 20.

[7] Island Health Authority. Response to request for data in support of the PHO report [email from C Diplock]; 2022 Apr 20.

[8] Northern Health Authority. Response to request for data in support of the PHO report [email from S Wadden]; 2022 Apr 26.

[9] Comox Valley Regional District. Fresh, filtered Comox valley water. Comox valley water treatment project backgrounder – Sept 2021. [Internet]. Available from: *https://www.comoxvalleyrd.ca/sites/default/files/docs/Services/Water/cvrd_wtp_backgrounder_september2021_final.pdf*.

[10] BC Office of the Auditor General of British Columbia. The protection of drinking water. An independent audit report. [Internet]. Victoria, BC. BC Office of the Auditor General; 2019, Jul [cited 2022 Apr 21]. Available from: *https://www.bcauditor.com/sites/default/files/publications/reports/OAGBC_Protection-of-Drinking-Water_RPT.pdf*.

[11] BC Office of the Provincial Health Officer. Clean, safe, and reliable drinking water: an update on drinking water protection in BC and the action plan for safe drinking water in British Columbia 2019. [Internet]. Victoria, BC: BC Office of the Provincial Health Officer; 2019 [cited 2021 Nov 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/pho-drinking-water-report-2019.pdf*.

[12] BC Office of the Provincial Health Officer and BC Ministry of Health. An investigation into the purpose and utility of drinking water protection plans under B.C.'s Source Water Protection Framework; [unpublished]. Victoria, BC: BC Office of the Provincial Health Officer and BC Ministry of Health; 2022 Aug 18.

[13] BC Ministry of Health. Action plan and progress assessment (APPA) for the implementation of audit recommendations from the OAG [prepared for the Select Standing Committee of Public Accounts]. [Internet]. Victoria, BC: BC Ministry of Health; 2019 [cited 2022 Aug 18]. Available from: *https://www.leg.bc.ca/content/CommitteeDocuments/41st-parliament/4th-session/pac/20191217_GovtActionPlan_Drinking-Water.pdf*.

[14] Office of the Premier. New ministers appointed for land stewardship, municipal affairs. [Internet]. Victoria, BC: Officer of the Premier; 2022 Feb [cited 2022 Sep 27]. Available from: *https://news.gov.bc.ca/releases/2022PREM0011-000268*.

[15] BC Ministry of Environment and Climate Change Strategy. Key messages: Watershed Security Strategy and Fund; [unpublished]. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; 2022 Jan 20.

[16] Pinches, C. Personal communication. BC Ministry of Land, Water and Resource Stewardship; 2023 Aug 30.

[17] Drinking Water Protection Regulation [B.C. Reg. 200/2003] [statute on the Internet]; [cited 2021 Dec 15]. Available from: *http://www.bclaws.ca/civix/document/id/complete/statreg/200_2003*.

[18] BC Ministry of Health. Guidance document for determining groundwater at risk of containing pathogens (GARP). Version 3. [Internet]. Victoria, BC: BC Ministry of Health; 2017 Sep [cited 2022 Feb 23]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/garp_assessment_oct_2017.pdf*.

CHAPTER

4

Drinking Water Treatment and Distribution

Drinking water treatment and distribution are integral components of the multi-barrier approach to safe drinking water. After the quality and quantity of the source water is assessed and hazards are identified, the next step in implementing the multi-barrier approach is to understand the treatment processes that are in place, including their limitations. Ensuring that effective treatment processes are in place, and that the water is protected from further contamination as it moves through the distribution system are vital to the safety of drinking water. This chapter covers treatment and distribution performance indicator status, construction permits, and new Ministry of Health (HLTH) guidance documents.

4.1 Treatment and Distribution

In BC, the minimum goals for providing drinking water treatment are based on HLTH's guidance documents, *Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies in British Columbia (2012)*[1] and the *Drinking Water Treatment Objectives (Microbiological) for Ground Water Supplies in British Columbia (2015)*,[2] which are both derived from the *Guidelines for Canadian Drinking Water Quality*. The Provincial Health Officer (PHO) had previously designated the meeting of treatment objectives as the basis for assessing the adequacy of drinking water treatment systems in BC.[3] Based on their current data systems, regional health authorities are not able to track water systems that meet treatment objectives. However, work is underway to address this data gap, which will help the PHO evaluate the progress drinking water systems are making in meeting the treatment objectives.

The regional health authorities are making efforts to measure the progress that water supply systems are making in protecting distribution systems; however, the data are incomplete and not reportable at this time. The indicators that measure distribution system protection, as highlighted in the 2019 PHO drinking water report, include the following:

- Having a cross-connection control program and/or backflow prevention devices in place.
- Monitoring and maintaining disinfection residual within the distribution system.
- Following a leak and pressure detection plan or schedule that meets best practices or operating permit requirements.
- Following a maintenance plan and schedule that meets best practices or operating permit requirements.
- Having a corrosion control program or plan in place where required.[3]

4.2 Construction Permits

Under section 6(1) of the Drinking Water Protection Regulation (DWPR), public health engineers who are employed by the regional health authorities' health protection programs are delegated the duty as issuing officials to review and issue construction permits for water supply systems.[4] The construction permit process ensures that proposed new systems or alterations to existing systems meet appropriate public health engineering standards for that type of system, which in turn ensures that the design of the water system provides the water supplier

with the ability to provide safe, clean, and reliable drinking water to end users when the system is operated appropriately.

The issuing official may waive the requirement for a construction permit for small systems under section 6(3)(c) of the DWPR.[4] The 2022 version of the *Drinking Water Officers' Guide* outlines several considerations to help DWOs decide when to waive a construction permit.[5]

Table 4.1 shows the number of construction permits issued across all health regions for the 2017/18 to 2021/22 fiscal years. On average, 790 permits were issued each year of the past five fiscal years. Improvements/upgrades and extensions accounted for most of the construction permits, at 40 and 50 per cent of the total, respectively. New systems and construction permit waivers accounted for the remaining 11 per cent of the total permits.

In 2017/18, 14 per cent more construction permits were issued than in 2016/17 (n = 784), as reported in the 2019 PHO drinking water report, which was the largest change over the period from 2017/18 to 2021/22. In 2020/21, the number of permits issued was down 6 per cent compared to 2016/17, which represented the fewest issued over that same period. However, while there were fluctuations each year, the overall total remained consistent.

4.3 Guidance Document Updates

HLTH has developed new guideline documents that will be used by public health professionals, water suppliers, drinking water professionals, regulatory agencies, and other interested parties and partners in BC who are involved in the design, construction, and approval of drinking water systems. In addition to the guidelines below, HLTH has developed guidelines for lead and manganese, which are detailed in Chapter 6: Section 6.2 of this report.

The following are two recently published guideline documents:

- *Guidelines for Ultraviolet Disinfection of Drinking Water* (2022)
  - provide guidance on the reduction of pathogenic microorganisms in drinking water using ultraviolet (UV) disinfection, and the design, operation, and maintenance of UV equipment for drinking water applications.[6]
- *Guidelines for Pathogen Log Reduction Credit Assignment* (2022)
  - provide guidance on pathogen log reduction credit assignment for the production of microbiologically safe drinking water based on the type of treatment processes used and the applicable pathogen log reduction credit assignment criteria being met.[7]

Table 4.1: Number of Construction Permits by Fiscal Year, BC, 2017/18 to 2021/22

Fiscal Year	Improvements/ Upgrades	Extensions	New Systems	Construction Permit Waivers	Total
2017/18	319*	498*	44*	29	**890**
2018/19	326*	365*	39*	23	**753**
2019/20	364	347	60	48	**819**
2020/21	238	416	41	42	**737**
2021/22	319	337	41	56	**753**
Total	**1,566**	**1,963**	**225**	**198**	**3,952**

Note: *The counts for improvements, extensions, and new systems for the 2017/18 and 2018/19 fiscal years are not exact. They are approximations because Northern Health's data system could produce only a combined total rather than individual counts. These values were calculated based on a ratio from the 2019/20 to 2020/21 fiscal years where exact data were available, which was then applied to the combined count of these categories provided by Northern Health. The total for each fiscal year is an accurate count of construction permits issued among the health regions.

Source: Regional health authorities; 2017/18–2021/22.

The following guideline document was released during the development of this report (2023):

- *Design Guidelines for Drinking Water Systems in British Columbia:*
  - help ensure that water treatment and distribution system infrastructure meet provincial requirements for the provision of safe, clean, and reliable drinking water;
  - provide clear guidance that will increase the efficiency and consistency of the design, review, and approval processes for the construction of new drinking water systems and when making changes to existing systems; and
  - build on leading practices currently in place in BC, incorporate applicable standards from other jurisdictions, and reflect the diversity of water systems that serve communities across the province.[8]

The *Drinking Water Officers' Guide* has incorporated the new guidance documents, in addition to other updates and improvements to clarity, consistency, and accessibility.[5] These new guidance documents are a direct response to the 2019 PHO drinking water report Recommendation 15, which asked HLTH to:

> Develop provincial guidance for a) the assignment of log reduction credits for the evaluation of treatment processes against treatment objectives, and b) the design of waterworks.[3]

The new $75 million Rose Valley Water Treatment Plant in West Kelowna is near completion. In 2017, the City of West Kelowna was awarded a $41 million federal and provincial grant under the Clean Water and Wastewater Fund to advance work on a new water treatment plant to provide clean drinking water to more than 18,000 residents served by the Lakeview, Pritchard/Sunnyside, and West Kelowna Estates water systems. Site clearing began in 2019, and plant construction commenced in 2020. The plant was scheduled to be in operation in 2023; however, the McDougall Creek wildfire during the summer of 2023 has delayed completion of the project.[11,12] (Top left) filters being disinfected; (top right) chemical storage bins; (bottom left) ultraviolet reactors; (bottom right) skimmers on top of dissolved air flotation tanks.

Photo credits: City of West Kelowna.

4.4 Infrastructure Funding Programs

The Local Government Infrastructure and Finance Branch of the Ministry of Municipal Affairs (MUNI) supports the development of sustainable drinking water infrastructure with two types of grants: infrastructure planning grants and capital grants. Between 2017/18 and 2021/22, 65 infrastructure planning grants and 38 capital grants were provided for drinking water-related projects (*Table 4.2*).

As outlined in the 2019 PHO drinking water report, only local governments systems (municipalities or regional districts) are eligible to apply for these grants. Municipalities or regional districts can also apply for infrastructure planning grants[a] on behalf of improvement district or other small water system projects.[9] They may also apply for capital grants for improvement district or small water system improvements on the condition that the system is transferred to the municipality or regional district. Capital grants typically cover two-thirds of a project's cost.

Table 4.2: Funded Drinking Water Projects, BC, 2017/18 to 2021/22

Program	Number of Projects	Total Gross Project Costs	Provincial Share	Federal Government Share	Combined Provincial & Federal Shares
Canada Community-Building Fund, Strategic Priorities Fund	14	$52,193,173	$0	$44,970,336	$44,970,336
Investing in Canada Infrastructure Program – Environmental Quality Program	13	$251,218,977	$67,273,112	$86,148,720	$153,421,832
Investing in Canada Infrastructure Program – Rural and Northern Communities Program	9	$17,838,058	$7,321,432	$10,146,635	$17,468,058
Small Communities Fund	1	$639,860	$213,286	$213,286	$426,572
One-off Project	1	$12,000,000	$12,000,000	$0	$12,000,000
Infrastructure Planning	65	$2,098,313	$618,067	$0	$618,067
Totals	**103**	**$335,988,381**	**$87,425,888**	**$141,478,977**	**$228,904,865**

Note: The data presented for the Canada Community-Building Fund, Strategic Priorities Fund (formerly Gas Tax Fund), administered by the Union of BC Municipalities, represent the second intake of the program. The data presented for Investing in Canada Infrastructure Program – Environmental Quality Program and Rural and Northern Communities Program represent the first intake and second intake of each program.

Source: BC Ministry of Municipal Affairs, 2022.[10]

[a] Infrastructure planning grants provide up to a maximum of $10,000 per grant application.

REFERENCES

[1] BC Ministry of Health. Drinking water treatment objectives (microbiological) for surface water supplies in British Columbia. Version 1.2. [Internet]. Victoria, BC: BC Ministry of Health; 2022 Nov [cited 2022 Sep 09]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_b_-_5_surface_water_treatment_objectives.pdf*.

[2] BC Ministry of Health. Drinking water treatment objectives (microbiological) for ground water supplies in British Columbia. Version 1.2. [Internet]. Victoria, BC: BC Ministry of Health; 2022 Nov [cited 2022 Sep 09]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_b_-_6_ground_water_treatment_objectives.pdf*.

[3] BC Office of the Provincial Health Officer. Clean, safe, and reliable drinking water: an update on drinking water protection in BC and the action plan for safe drinking water in British Columbia 2019. [Internet]. Victoria, BC: BC Office of the Provincial Health Officer; 2019 [cited 2021 Nov 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/pho-drinking-water-report-2019.pdf*.

[4] Drinking Water Protection Regulation [B.C. Reg. 200/2003] [statute on the Internet]; [cited 2021 Dec 15]. Available from: *http://www.bclaws.ca/civix/document/id/complete/statreg/200_2003*.

[5] BC Ministry of Health. Drinking water officers' guide: part A. [Internet]. Victoria, BC: BC Ministry of Health; 2022 [cited 2022 May 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_a_-_legislative_requirements.pdf*.

[6] BC Ministry of Health. Guidelines for ultraviolet disinfection of drinking water. [Internet]. Victoria, BC: BC Ministry of Health; 2022 [cited 2022 May 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/dwog_part_b_-_16_ultraviolet_disinfection_of_drinking_water.pdf*.

[7] BC Ministry of Health. Guidelines for pathogen log reduction credit assignment. [Internet]. Victoria, BC: BC Ministry of Health; 2022 [cited 2022 May 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/dwog_part_b_-_15_pathogen_log_reduction_credit_assignment.pdf*.

[8] BC Ministry of Health. Design guidelines for drinking water systems in British Columbia; [unpublished]. Victoria, BC: BC Ministry of Health; 2022 May 18.

[9] BC Ministry of Municipal Affairs. Infrastructure planning grant program. [Internet]. Victoria, BC: BC Ministry of Municipal Affairs. Available from: *https://www2.gov.bc.ca/gov/content/governments/local-governments/grants-transfers/grants/infrastructure-planning-grant-program*.

[10] BC Ministry of Municipal Affairs. Response to request for data in support of the PHO report [email from B Bedford]; 2022 Mar 18.

[11] City of West Kelowna. Rose Valley Water Treatment Plant. [Internet]. [cited 2023 Oct 16]. Available from: *https://www.westkelownacity.ca/en/our-community/rose-valley-water-treatment-plant-project.aspx*.

[12] Castanet. Wildfire slows water plant - West Kelowna water treatment plant should still come on line sometime this fall. [Internet]. [cited 2023 Oct 16]. Available from: *https://www.castanet.net/news/West-Kelowna/449041/West-Kelowna-water-treatment-plant-should-still-come-on-line-sometime-this-fall#:~:text=The%20McDougall%20Creek%20wildfire%20will%20have%20an%20impact,plant%20to%20come%20on%20line%20sometime%20this%20fall*.

A Public Health Technologist from the BC Centre for Disease Control Public Health Laboratory reading bacterial heterotrophic plate counts for microbiological water quality testing.

Photo credit: BC Centre for Disease Control Public Health Laboratory.

PART 3:

Total Quality Management

Once the key components are in place from source to tap, the next step in the multi-barrier approach requires that those components be monitored, managed, and operated effectively and consistently to provide a reliable source of clean and safe drinking water. Part 3 describes the necessary activities and programs for good operations and management of water supply systems to ensure the delivery of clean, safe, and reliable drinking water. The specific activities and programs discussed include operations and management (Chapter 5), monitoring and reporting (Chapter 6), and abatement and enforcement (Chapter 7).

CHAPTER

5

Operations and Management

The production and delivery of clean, safe, reliable drinking water depends on the proper operation, maintenance, and management of the waterworks system.[1] This chapter covers facility classification and operator certification, and emergency response and contingency plans.

5.1 Facility Classification and Operator Certification

The Environmental Operators Certification Program (EOCP) classifies water and wastewater facilities, and oversees the certification of water and wastewater operators. It acts as an agent of the Ministry of Health (HLTH) under a Memorandum of Understanding[2] (which supports the requirements defined in the Drinking Water Protection Regulation [DWPR]) and is incorporated as a non-profit society with an elected board of directors. The following subsections describe water system facility classification, operator certification, and strategic improvements made to both those functions during this reporting period.

5.1.1 Water System Facility Classification

In BC, the EOCP classifies water systems and certifies operators using standards adopted by the Association of Boards of Certification. Water system facility classifications include small water system, water distribution system (Levels I to IV), and water treatment system (Levels I to IV). Classification levels are based on a system's operational complexity. This is determined by an overall point score, where points are given based on (1) the level of technical complexity, (2) the capacity (size), and (3) the population served. Level IV represents the highest level of complexity for either water distribution or water treatment systems; however, certification for Level IV operators is not a requirement under the DWPR. A water system's facility classification determines the required certification level (i.e., the degree of knowledge and training an operator must have) for the operator of that system. *Table 5.1* shows the number of water distribution and water treatment systems at each classification level (I to IV) over the past five years.

Since 2018, the number of facilities classified by the EOCP has remained largely the same, although there have been slight variations each year. Beginning in 2021, the EOCP began to track water system classifications and operator certifications based on their status with the EOCP—active versus expired. The EOCP requires all water treatment and distribution systems to reclassify every five years and following any major process change. If a water system owner fails to reclassify, the EOCP flags the system as expired. *Table 5.1* indicates that in 2021, 155 facilities had an expired classification status: 27 per cent of the water distribution facilities and 18 per cent of the water treatment facilities. For 2022, 144 facilities had an expired classification status: 24 per cent of water distribution facilities and 18 per cent of water treatment facilities. Unfortunately, for expired systems, it is not explicitly stated why facility owners have not renewed their classification. For example, they may have forgotten to submit their classification renewal forms, they may have retired or changed careers, or the system may no longer be operational.[3] Without this information, it is difficult to identify, and propose solutions to, administrative problems or compliance issues. The EOCP, through its communications

Table 5.1: Number of Water Distribution and Water Treatment Facilities, by Level of Classification, 2018 to 2022

Year	Type of System	Classification Level				Total
		IV	III	II	I	
2018	Water Distribution	33	53	175	159	**420**
	Water Treatment	18	41	124	54	**237**
2019	Water Distribution	35	62	172	145	**414**
	Water Treatment	19	42	123	63	**247**
2020	Water Distribution	33	65	177	136	**411**
	Water Treatment	21	41	119	70	**251**
2021	Water Distribution	27	73	137	58	**295**
	Water Treatment	22	33	88	76	**219**
	Water Distribution (Expired)	4	5	38	61	**108**
	Water Treatment (Expired)	3	6	32	6	**47**
2022	Water Distribution	27	74	143	63	**307**
	Water Treatment	22	33	93	78	**226**
	Water Distribution (Expired)	4	4	34	54	**96**
	Water Treatment (Expired)	3	5	31	9	**48**

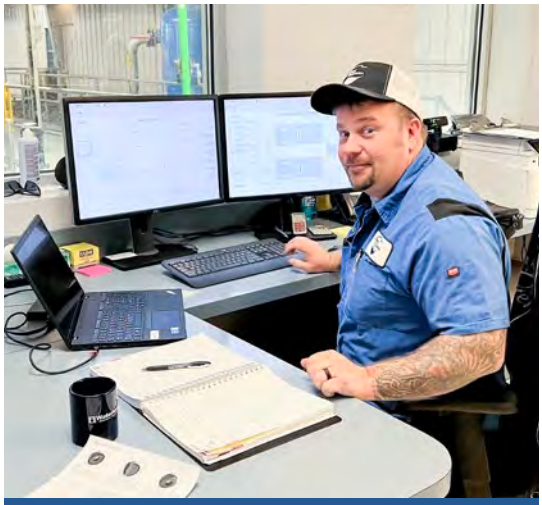
Note: Expired facilities is an internal flag set within the Environmental Operators Certification Program Customer Relations Manager system. It indicates that a facilities classification status is expired and needs to be renewed. It does not imply an operational status. Data are included here for completeness.

Source: Environmental Operators Certification Program; 2017/18–2021/22.

project (see Section 5.1.3), attempts to work with non-compliant facilities to resolve outstanding issues. However, more data would be needed to determine the project's effectiveness.

5.1.2 Operator Certification

Water suppliers must ensure that the operators of the water supply system meet the necessary training or certification requirements. The *Drinking Water Protection Act* (DWPA) (section 9) requires that a person not operate, maintain, or repair a prescribed water system unless they are qualified in accordance with the regulations or is doing so under the supervision of a person who is qualified.[4] The DWPR (section 12) states that a person is qualified to operate, maintain, or repair a water system if they have been certified by the EOCP for that class of system.[5]



Kyle Arsenault, a certified water and wastewater operator, working at the Powers Creek Water Treatment Plant in West Kelowna. The plant is classified as a Level IV water treatment facility.

Photo credit: Kalpna Solanki, Environmental Operator Certification Program President and CEO.

Table 5.2 shows the number of operators certified by the EOCP based on their level of certification. Prior to 2021, operator certification had increased year over year by an overall average of 4 per cent for water distribution and 8 per cent water treatment from 2018 to 2020. This was followed by a decline of 19 per cent for water distribution and 8 per cent for water treatment in 2021, and a further decline of 14 per cent for water distribution and 19 per cent for water treatment in 2022 compared to 2020. The decrease was attributed largely to the tracking system at EOCP, which flagged operators as "not in good standing" rather than interruptions in operator training during the COVID-19 pandemic. EOCP did not relax training requirements during the pandemic because many training providers offered online training options. Data on operators who were not in good standing were not available prior to 2022. Based on the data for 2022, 32 per cent of water distribution operators and 25 per cent of water treatment operators were "not in good standing". The number of certified operators can fluctuate for a number of reasons, such as the criteria set out by the EOCP may not be met, or operators may have retired or left the industry.[6] At this time, no linkage can be made between the number of operators "not in good standing" and possible reasons for fluctuations in their numbers, which makes it difficult to recommend options for, or solutions to, the current classification regime.

As discussed in the 2019 Provincial Health Officer's (PHO) drinking water report, the Office of the Provincial Health Officer and the regional health authorities identified, for systems that serve more than 500 people per day, the need to have at least one operator certified to the level of classification for the system as an indicator of good operations.[7] Regional health authorities are able to track and report this in some capacity, although data system limitations still restrict data completeness. Northern Health was unable to report data for 2020, and Vancouver Coastal Health was unable to report data for 2021 and 2022.[a]

Table 5.2: Number of Certified Water Distribution and Water Treatment Operators, by Certification Level, 2018 to 2022

Year	Type of System	Classification Level				Total
		IV	III	II	I	
2018	Water Distribution	83	178	740	782	**1,783**
	Water Treatment	44	83	220	340	**687**
2019	Water Distribution	85	191	778	831	**1,885**
	Water Treatment	49	98	243	373	**763**
2020	Water Distribution	90	192	807	839	**1,928**
	Water Treatment	54	110	249	377	**790**
2021	Water Distribution	73	167	640	675	**1,555**
	Water Treatment	56	100	235	337	**728**
2022	Water Distribution	80	143	580	534	**1,337**
	Water Distribution – Not in Good Standing	17	66	253	293	**629**
	Water Treatment	55	76	207	249	**587**
	Water Treatment – Not in Good Standing	6	19	63	106	**194**

Note: Expired operator certification counts were not available prior to 2022.
Source: Regional health authorities; 2017/18–2021/22.

[a] Northern Health indicated that it could not accurately report on data for this indicator for the 2020 because those data were not maintained for that year; however, data were reportable for the following years. Vancouver Costal Health does not track this indicator in its data system. The information for 2020 was determined through manual entry of data by staff at the regional health authority. Resource limitations prevented this indicator from being reported in the following years.

With those outliers removed, regional health authority data for the 2020, 2021, and 2022 years indicated that 63, 59, and 86 per cent of large systems that served more than 500 people per day, respectively, had at least one operator certified to the level of classification for the system (*Figure 5.1*).

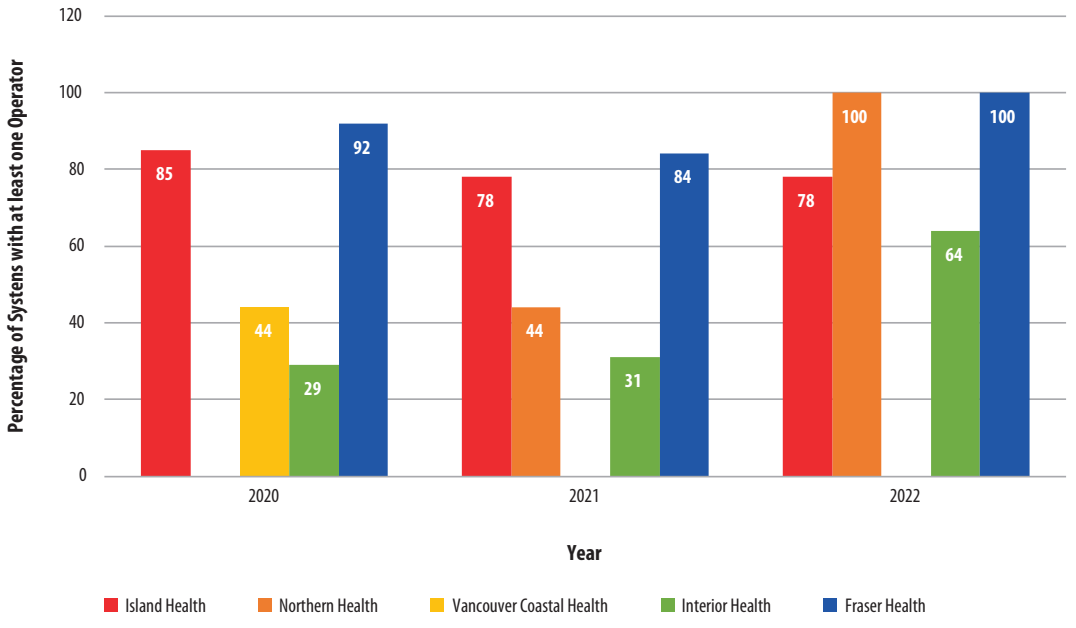
5.1.3 Environmental Operators Certification Program/Health Authority Communication Project

To help regional health authorities with enforcement of drinking water systems, EOCP and the regional health authorities established the Environmental Operators Certification Program/Health Authority Communication Project.[8] EOCP maintains a database of all water supply facilities, which includes the status of all classified systems and the certification level and status of water system operators. The database supports business functions for EOCP, water suppliers, and drinking water officials under the DWPR.[8] Using information from the database, EOCP identifies potentially non-compliant water supply facilities and operators, and contacts the facility owner or operator to let them know of the non-compliance and the steps they can take to correct it. If, after two communications from EOCP, the facility or operator has not taken any action and continues to be in non-compliance, EOCP forwards the case to the relevant regional health authority for action.[8]

5.2 Emergency Response and Contingency Plans

Every owner and operator of a water supply system must be aware of situations that could cause an operational interruption that threatens drinking water safety, and have plans in place to respond to those events. Section 10 of the DWPA requires prescribed water systems to have an emergency response and contingency plan in accordance with section 13 of the DWPR.[4,5] Emergency response and contingency

Figure 5.1: Percentage of Large Water Systems Serving > 500 People per Day with at Least One Operator Certified to the Level of Classification for the System, BC, as of March 31, 2020 to 2022



Note: 2020 data were not available for Northern Health; 2021 and 2022 data were not available for Vancouver Coastal Health. Data prior to 2020 were not available from health authorities due to data system limitations.

Source: Regional health authorities; 2019/20–2021/22

plans outline measures and actions to address impactful conditions, detail the responsibilities of operators and staff, and ensure communication with officials and the public. To help water suppliers complete emergency response and contingency plans, HLTH has developed the *Guide to Emergency Response and Contingency Plans for Water Supply Systems* and the *Guide for Communicating with Water Users* (released in 2023).[b]

Table 5.3 shows the number and percentage of water systems within each regional health authority that have an accepted emergency response and contingency plan. Collection of these data was previously difficult because data systems were not set up to capture and distinguish between large and small systems. However, due to the implementation of the steps described in the previous PHO drinking water report, data collection has improved.[7] Starting in March 31, 2020, each regional health authority was able to identify the number and percentage of water systems that had an accepted emergency response and contingency plan (ERCP). Large water systems generally have higher compliance rates than small water systems (*Table 5.3*) because they usually have paid operators with increased levels of training and the operational knowledge required to develop and execute an emergency response and contingency plan. Both large and small water systems within Interior Health that had an accepted ERCP reported a considerable decrease in compliance with this indicator for 2020 and 2021 compared to 2019. Data for 2019 were estimated based on previous completion rates, whereas the data for 2020 and 2021 were from actual counts; however, completion rates in 2020 and 2021 were low because ERCP reporting had not been set as a program target. Subsequent auditing of this indicator yielded the decrease reported in *Table 5.3*.

Table 5.3: Number and Percentage of Water Systems with an Accepted Emergency Response and Contingency Plan, by Regional Health Authority, BC, as of March 31, 2018 to 2022

Regional Health Authority	Water System Size	2018	2019	2020	2021	2022
Island Health	Small	–	665 (79%)	725 (80%)	754 (83%)	775 (87%)
	Large	–	80 (86%)	78 (88%)	78 (89%)	78 (89%)
	Total	**867 (93%)**	**745 (80%)**	**803 (81%)**	**832 (84%)**	**853 (87%)**
Northern Health	Small	501 (51%)	501 (51%)	636 (54%)	606 (51%)	744 (62%)
	Large	93 (61%)	93 (61%)	58 (94%)	62 (100%)	62 (98%)
	Total	**594 (52%)**	**594 (52%)**	**694 (56%)**	**668 (53%)**	**806 (64%)**
Vancouver Coastal Health	Small	–	–	260 (78%)	245 (76%)	255 (77%)
	Large	–	–	16 (47%)	33 (83%)	34 (92%)
	Total	**285 (82%)**	**277 (79%)**	**276 (75%)**	**278 (77%)**	**289 (79%)**
Interior Health	Small	518 (30%)	771 (43%)	246 (14%)	259 (14%)	281 (15%)
	Large	25 (16%)	103 (67%)	54 (36%)	70 (47%)	99 (68%)
	Total	**543 (28%)**	**874 (45%)**	**300 (16%)**	**329 (17%)**	**380 (19%)**
Fraser Health	Small	402 (100%)	410 (100%)	406 (99%)	401 (100%)	392 (100%)
	Large	43 (100%)	39 (100%)	39 (100%)	43 (100%)	37 (100%)
	Total	**445 (100%)**	**449 (100%)**	**445 (99%)**	**444 (100%)**	**429 (100%)**

Note: Island Health could provide only a total for 2018. Vancouver Coastal Health could provide only totals for 2018 and 2019.
Source: Regional health authorities; 2017/18–2021/22.

[b] These resources for water system operators are available at: *https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/drinking-water-quality/resources-for-water-system-operators*

REFERENCES

[1] Canadian Council of Ministers of the Environment. From source to tap: guidance on the multiple-barrier approach to safe drinking water. [Internet]. Winnipeg MB: Federal-Provincial-Territorial Committee on Drinking Water and the CCME Water Quality Task Group; 2004 [cited 2022 Jun 14]. Available from: *https://ccme.ca/en/res/sourcetotap-finalenglish03-28-04.pdf*.

[2] BC Ministry of Health and Environmental Operators Certification Program Society. Memorandum of Understanding. Victoria, BC: BC Ministry of Health and Environmental Operators Certification Program Society; 2005 Jan 11.

[3] Solanki K. Personal communication. Environmental Operators Certification Program; 2021 May 18.

[4] Drinking Water Protection Act [SBC 2001, c.9] [statute on the Internet]; [cited 2021 Dec 14]. Available from: *http://www.bclaws.ca/civix/document/id/complete/statreg/01009_01*.

[5] Drinking Water Protection Regulation [B.C. Reg. 200/2003] [statute on the Internet]; [cited 2021 Dec 15]. Available from: *http://www.bclaws.ca/civix/document/id/complete/statreg/200_2003*.

[6] Environmental Operators Certification Program. Environmental Operators Certification Program (EOCP) data submission in response to request for updates to the status of drinking water in British Columbia 2017/18 to 2021/22 [email from K Solanki]; 2022 Jun 28.

[7] BC Office of the Provincial Health Officer. Clean, safe, and reliable drinking water: an update on drinking water protection in BC and the action plan for safe drinking water in British Columbia 2019. [Internet]. Victoria, BC: BC Office of the Provincial Health Officer; 2019 [cited 2021 Nov 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/pho-drinking-water-report-2019.pdf*.

[8] Environmental Operators Certification Program. Environmental Operators Certification Program (EOCP) and B.C. health authorities communication process for drinking water supply systems: 2020 June. [Internet]. [cited 2022 July 11]. Available from: *https://eocp.ca/wp-content/uploads/2020/07/HA_EOCP-Communication-Process-Communique.pdf*.

CHAPTER

6

Monitoring and Reporting

The multi-barrier approach requires that drinking water systems are managed and operated in a holistic manner from source to tap, to ensure drinking water is kept clean, safe, and reliable over the long term. Proper monitoring and reporting demonstrate that good management and operation have occurred. Holistic monitoring of drinking water includes source water quality monitoring, performance monitoring, and water quality compliance monitoring. This depends on the accuracy, reliability, and timely reporting of water quality sampling results from approved and accredited laboratories. Records of monitoring results must be kept and reported on regularly to keep water users and decision makers informed. Reporting often includes water system annual reports, public notification of water quality concerns, and waterborne disease surveillance. This chapter describes the guidelines and the monitoring and reporting activities that occurred in BC during the reporting period.

6.1 Guidelines for Canadian Drinking Water Quality

Health Canada leads the Federal-Provincial-Territorial Committee on Drinking Water (Committee on Drinking Water), which develops and publishes the *Guidelines for Canadian Drinking Water Quality* (the Canadian guidelines).[1] This committee also produces technical documents on specific microbiological, chemical, and radiological parameters, as well as other guidance documents related to the delivery of potable water.[2] The Canadian guidelines set out the maximum acceptable concentration (MAC) for substances in drinking water. These limits are based on scientific studies that examine potential harm from both short-term and long-term exposure to a parameter at concentrations above certain levels.[3]

The Committee on Drinking Water also develops aesthetic quality guidelines—known as aesthetic objectives (AO)—that address concerns with physical characteristics of water, such as taste and odour. Operational guidelines are developed for parameters that may affect processes at a treatment plant or in the drinking water distribution system (e.g., an operational guideline was developed for aluminum for treatment plants that use aluminum-based coagulants).[3]

From 2018 to 2022, Health Canada and the Committee on Drinking Water developed or updated guideline technical documents for 27 parameters and developed six guidance documents (*Table 6.1*). No guidelines or guidance documents were released in 2017.[2]

6.1.1 Guidelines for Canadian Drinking Water Quality – Manganese

In 2019, Health Canada updated the *Guidelines for Canadian Drinking Water Quality* for manganese in drinking water. The update provided a revised AO and a newly introduced MAC for manganese.[4] In response to this change, the BC Ministry of Health (HLTH) developed the document *Guidance on Manganese in Drinking Water*, which was added to the BC *Drinking Water Officers' Guide* (Part B: Section 13) in May 2019. Manganese is an essential element in the human diet; however, high levels in drinking water may increase the risk of harming brain development in infants and young children.[4] The updated guidance sets a MAC of 0.12 mg/L, which is based on protecting infants who consume powdered formula made with tap water, and an AO of 0.02 mg/L, which was revised to address complaints about discoloured water.[5]

Table 6.1: Guidelines for Canadian Drinking Water Quality – Guideline Technical Documents and Guidance Documents Released, Health Canada, 2018 to 2022

Year	Guideline Technical Documents	Guidance Documents Developed
2018	Bromate, chromium, cyanobacterial toxins, perfluorooctane sulfonate, perfluorooactanoic acid	–
2019	Enteric protozoa, enteric viruses, copper, lead, manganese, strontium, uranium	*Guidance on the Use of Quantitative Microbial Risk Assessment in Drinking Water*
2020	Escherichia coli (*E. coli*), total coliform, barium, cadmium, chloramines	*Guidance on Natural Organic Matter in Drinking Water; Guidance on the Use of Enterococci as an Indicator in Canadian Drinking Water Supplies*
2021	Aluminum, 1,4-dioxane, metribuzin	*Guidance on the Temperature Aspects of Drinking Water; Overview of the Microbiological Aspects of Drinking Water Quality*
2022	Bromoxynil, dicamba, 2,4-dichlorophenoxyacetic acid (2,4-D), dimethoate, omethoate, diquat, 2-methyl-4-chlorophenoxyacetic acid	*Guidance on Monitoring the Biological Stability of Drinking Water in Distribution Systems*

Source: Health Canada. Guidelines for Canadian Drinking Water Quality summary table; 2020. Health Canada. Water Quality – Reports and Publications; 2022.

In 2019, construction began on a new water treatment plant for the Village of Burns Lake, where manganese levels in the groundwater source exceeded the new maximum allowable concentration (MAC) in the *Guidelines for Canadian Drinking Water Quality*. The new filters (pictured above) that were installed as part of the project have brought manganese levels down below the MAC and have reduced arsenic levels. The $4,800,000 project was made possible with funding from the Province ($1,599,840) and the federal government ($1,920,000), and with financial contributions for the remainder from the Village of Burns Lake, Lake Babine Nation, and Burns Lake Band.[6,7]

Photo credit: Ministry of Municipal Affairs.

6.1.2 Guidelines for Canadian Drinking Water Quality – Lead

Lead is a naturally occurring element in the environment. It can occur in drinking water due to its prevalence in older plumbing fixtures and in solder used to join pipes. As water sits in the plumbing, lead can leach from the components and pipes, especially if the water is considered to be "aggressive" (i.e., it has as a low pH and/or alkalinity).

In 2019, Health Canada updated the *Guidelines for Canadian Drinking Water Quality* for lead in drinking water. The MAC for total lead in drinking water was set at 0.005 mg/L, measured at the tap. Every effort should be made to keep lead levels in drinking water as low as reasonably achievable. The guideline was established to protect vulnerable adults, and children and infants because the ingestion of lead can impair cognitive, behavioural, and intellectual development.[8]

HLTH updated and published the *Guidelines on Evaluating and Mitigating Lead in Drinking Water Supplies, Schools, Child Care Facilities and Other Buildings* in 2019. This document provides guidance and tools for reducing lead in drinking water at the tap, identifying communities at risk of corrosive water, and screening and assessing lead in schools, child care facilities, and other buildings; it also provides possible mitigation strategies.[9]

Lead is usually not found in drinking water when it leaves the treatment plant; instead, it tends to leach out of pipes and fixtures in buildings or homes, or service lines that connect homes to water mains, depending on the nature of the plumbing materials used, the corrosiveness of the water, and the length of time the water has been stagnant in the plumbing. As a result, older facilities with intermittent water use patterns and older plumbing materials, such as schools, child care facilities, and office buildings, may have elevated levels of lead in their drinking water, which can occur periodically (i.e., first draw after a period of prolonged water stagnation in the plumbing) or can be sustained (e.g., the levels of lead in the water exceed guidelines even after flushing).[9]

The previous Provincial Health Officer (PHO) drinking water report made a recommendation titled "Lead in Drinking Water" (Schools) and "Lead in Drinking Water (Child Care Facilities)" (Recommendation 19a & 19b), which specified the following:

- Establish a consistent sampling and reporting protocol for lead in drinking water for schools to follow. Continue to develop plans to implement measures to effectively reduce lead in school drinking water.
- Develop plans to promote screening for, and implement measures to effectively reduce levels of, lead in the drinking water of child care facilities, recognizing that children under the age of six are the most vulnerable to the harmful effects of lead.[10]

An update to these recommendations is provided in Chapter 11 of this report.

6.1.3 Source Drinking Water Quality Guidelines

In 2020, the Ministry of Environment and Climate Change Strategy (ENV) coordinated with HLTH to complete an update to the BC *Source Drinking Water Quality Guidelines*. Key activities included reviewing the *Guidelines for Canadian Drinking Water Quality* to determine which ones were relevant and applicable to the source drinking water quality guidelines for BC, and to ensure that all human health-related information was correct.[11]

ENV regularly coordinates with HLTH to provide provincial feedback on the *Guidelines for Canadian Drinking Water Quality* and the *Guidelines for Canadian Recreational Water Quality*.[11]

6.2 Water Quality Compliance Monitoring

6.2.1 Bacteriological Monitoring

Section 11 of the *Drinking Water Protection Act* (DWPA) mandates that water suppliers monitor the drinking water source, the water in the system, and the water the system provides for specific parameters that have been established by the Drinking Water Protection Regulation (i.e., *E. coli*, fecal coliform, and total coliform) and by the system's operating permit.[12] Water systems should meet their required sampling frequency for bacteriological monitoring 90 per cent of the time, a target that was established by the PHO and the regional health authorities.

Table 6.2 shows the number and percentage of water systems across the regional health authorities that met the 90 per cent sampling frequency requirement for the fiscal years 2017/18 through 2021/22. Generally, more large water systems than small water systems met the sampling frequency reporting requirement, likely because large systems have a much greater operational and financial capacity to fulfill their requirements. Additionally, large system operators are highly trained and educated on monitoring and reporting requirements. It should be noted, however, that there are several gaps in the data. Data system limitations affected the results across health authorities due mainly to deficiencies in how water systems are counted based on size. Results for large water systems are generally more accurate than those for small water systems (data on small systems were provided for some years, but not with confidence due to data system limitations). Data for the 2021/22 fiscal year include information on community water systems only. Data on stand-alone water systems were not included due to data system limitations. These data cannot be directly compared to data for the previous fiscal years.

The data in *Table 6.2* also suggests that the COVID-19 pandemic affected the ability of many systems, both large and small, to meet the sampling frequency target requirement.

Table 6.2: Number and Percentage of Small and Large Water Systems Meeting the Sampling Frequency Requirement 90 Per Cent of the Time, BC, 2017/18 to 2021/22

Regional Health Authority	Water System Size	2017/18	2018/19	2019/20	2020/21	2021/22 Community Water Systems Only
Island Health	Small	306 (36%)	333 (40%)	336 (37%)	373 (41%)	255 (97%)
	Large	72 (79%)	75 (81%)	73 (82%)	60 (68%)	54 (75%)
	Total	**378 (41%)**	**408 (44%)**	**409 (41%)**	**433 (43%)**	**309 (92%)**
Northern Health	Small	–	–	436 (37%)	407 (34%)	66 (38%)
	Large	–	–	49 (79%)	49 (79%)	34 (100%)
	Total	**–**	**–**	**485 (39%)**	**456 (36%)**	**100 (48%)**
Vancouver Coastal Health	Small	114 (46%)	92 (30%)	106 (32%)	–	95 (59%)
	Large	18 (18%)	6 (12%)	1 (3%)	15 (83%)	25 (89%)
	Total	**132 (38%)**	**98 (28%)**	**107 (29%)**	**–**	**120 (64%)**
Interior Health	Small	12 (1%)	–	–	–	255 (36%)
	Large	15 (10%)	107 (70%)	110 (73%)	111 (74%)	27 (45%)
	Total	**27 (1%)**	**–**	**–**	**–**	**282 (36%)**
Fraser Health	Small	379 (94%)	368 (90%)	370 (90%)	250 (62%)	98 (83%)
	Large	43 (100%)	38 (97%)	39 (100%)	42 (97%)	29 (91%)
	Total	**442 (95%)**	**406 (90%)**	**409 (91%)**	**292 (66%)**	**127 (85%)**

Note: Reporting on the frequency requirement is averaged over the fiscal year. Data were not available for Northern Health from 2017/18 to 2018/19. Data were not available from Interior Health for small systems for 2018/19 to 2021. Data were not available for small systems from Vancouver Coastal Health for 2020/21. Vancouver Coastal Health and Fraser Health data are based on an 80 per cent compliance rate due to how these data were historically captured in their data system platforms. Results presented in the table may include data from seasonal operations, which has been noted to cause inconsistencies in how data are reported for those systems. Prior to 2021/22, Vancouver Coastal Health classified large systems as more than 300 connections, rather than using the definition of large system (>500 people served in a 24-hour period) in the Drinking Water Protection Regulation (DWPR).[15] For 2021/22, Vancouver Coastal Health used the DWPR definition of a large water system. Fiscal year 2021/22 presents data for community water systems only; stand-alone water systems were not included.

Source: Regional health authorities; 2017/18–2021/22.

The data shows a decrease in sampling ranging from 3–4 per cent to as high as 28 per cent. Specifically, Fraser Health reported at least 90 per cent compliance from 2017/18 to 2019/20 for small water systems; in 2020/21, the number of small water systems that met the sampling frequency decreased to 62 per cent. It is possible that this decrease was related to the effects of implementing pandemic public health measures. Additionally, while Vancouver Coastal Health and Interior Health were not able to report on small systems for the 2020/21 fiscal year, they each indicated that small systems in their regions encountered many of the same problems in meeting the sampling frequency requirement as those in other health regions due to the pandemic, such as issues with sampling, staffing, and transporting delays.[13,14] For the 2021/22 fiscal year, *Table 6.2* shows data only for community water systems. When compared to the rest of the data set (which includes stand-alone water systems), the data indicate that community water systems generally had a greater compliance rate for meeting the sampling frequency requirements.

6.2.2 Water Quality Testing – Chemical and Physical Parameters

In BC, drinking water officers (DWOs) use the *Guidelines for Canadian Drinking Water Quality* to define potability for prescribed water systems. While drinking water legislation in BC does not specifically prescribe chemical sampling parameters or frequencies, section 6 of the DWPA requires that all water systems provide potable water, and section 11 allows DWOs to prescribe sampling requirements on an operating permit.[12] As such, water suppliers must conduct chemical and radiological sampling at a frequency determined by the DWO to assess whether the drinking water exceeds any maximum acceptable concentration for health. Chemical and radiological testing of drinking water in BC is conducted by private water testing laboratories.

Chemical sampling for specific parameters may also be routinely required as a condition of a water supplier's operating permit in regions where source waters are identified as at risk of exceeding known chemical parameters from either a) naturally occurring elements (e.g., arsenic, manganese, uranium), b) land uses in the area (e.g., agriculture, industry, logging, recreation, and development), or c) by-products of disinfection or corrosion where source water chemistry is known to lead to their formation.

Regional health authorities are adapting their data systems to track the number of systems that are monitoring chemical water quality parameters in accordance with their monitoring plan. For the 2021/22 fiscal year, data were available only for community water systems[a] (*Table 6.3*). Large water systems generally have good compliance with chemical water quality testing, averaging 78 per cent compared to 41 per cent for small water systems, based on the health regions that were able to report. Chemical water quality sample results from private water testing laboratories cannot be

Table 6.3: Number and Percentage of Small and Large Community Water Systems Monitoring Chemical Water Quality in Accordance with Their Monitoring Plan, BC, 2021/22

Regional Health Authority	2021/22		
	Small	Large	Total
Island Health	81 (31%)	63 (88%)	**144 (43%)**
Northern Health	21 (12%)	24 (71%)	**45 (22%)**
Interior Health	580 (81%)	45 (75%)	**625 (81%)**

Note: Data were not available from Vancouver Coastal Health and Fraser Health. Prior to 2021/22, Vancouver Coastal Health classified large systems as more than 300 connections, rather than using the definition of large system (>500 people served in a 24-hour period) in the Drinking Water Protection Regulation (DWPR). For 2021/22, Vancouver Coastal Health used the DWPR definition of a large water system. Data include only community-based water systems, and not stand-alone water systems.

Source: Regional health authorities; 2021/22.

[a] Community water systems include local government water systems, water systems incorporated by the Comptroller of Water Rights, and independent water systems.

easily transferred electronically to regional health authority data systems, which makes reporting on chemical water quality testing data difficult.

Table 6.4, *Figure 6.1*, and *Figure 6.2* show the number of water systems with parameters that exceeded the *Guidelines for Canadian Drinking Water Quality* for fiscal years 2017/18 through 2021/22 based on whether the exceedance occurred at the source prior to treatment or in water delivered at the tap. An increase in water testing, improvements in data collection and recording within existing data systems, and an increase in the number of water systems built within areas where naturally occurring parameters are prevalent led to the discovery of more instances of arsenic, lead, and uranium that exceeded the MAC in drinking water.

In the 2020/21 and 2021/22 fiscal years, a number of systems had high exceedances of the new MAC for manganese, which was introduced in 2019 (see Section 6.1.1). Prior to 2019, there was no health-based guideline for manganese, only an AO.

A customer supplied by the Town of Osoyoos water system experienced a slug of manganese deposits in their drinking water after a nearby hydrant was disturbed. Physical disturbances to a distribution system can cause the release of manganese deposits from pipes. In June 2023, the Town of Osoyoos was granted $9 million to assist with water infrastructure projects to improve drinking water quality.

Photo credit: Jessica Kriese, Osoyoos, BC.

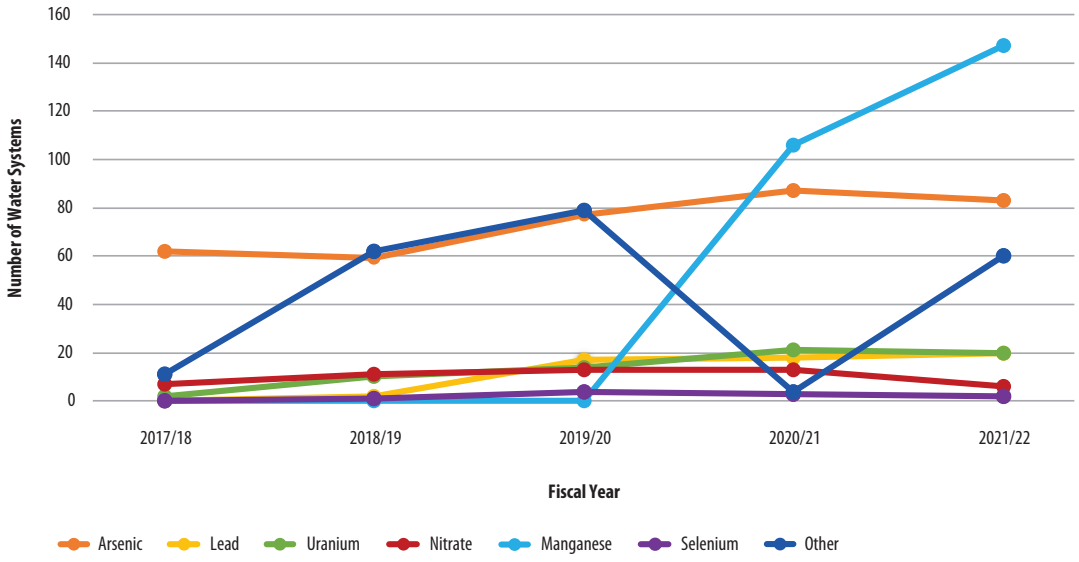
Table 6.4: Number of Water Systems Exceeding the Guidelines for Canadian Drinking Water Quality, BC, 2017/18 to 2021/22

Parameter of Concern	Health-based Guidelines – Exceedances in Maximum Acceptable Concentrations (MACs) at the Source and Delivered at the Tap									
	2017/18		2018/19		2019/20		2020/21		2021/22	
	Source	Delivered	Source	Delivered	Source	Delivered	Source	Delivered	Source	Delivered
Arsenic	62	6	59	13	77	27	87	33	83	30
Lead	0	0	2	0	17*	12	18*	12	20*	19
Uranium	2	1	10	6	14	12	21	16	20	14
Nitrate	7	5	11	4	13	5	13	7	6	5
Manganese	N/A	N/A	N/A	N/A	N/A	N/A	106	67	147	88
Selenium	0	0	1	1	4	3	3	2	4	2
Disinfection By-products	N/A	8	N/A	7	N/A	15	N/A	10	N/A	11
Other	11	2	62	4	79	60	4	13	60	6

Note: Exceedances are totalled among the regional health authorities. The Vancouver Coastal Health data system does not track compliance with the *Guidelines for Canadian Drinking Water Quality* (GCDWQ) – results were derived from communication with drinking water officer staff. Interior Health stated that the "source" numbers may be underreported due to the use of a custom form. Manganese was not added to the GCDWQ until 2019. The PHO did not start asking regional health authorities to include specific counts of manganese exceedances until the data request for 2020/2021; therefore, those exceedances in Manganese after the introduction of the MAC would be captured in the "Other" category for the 2018/19 and 2019/20 fiscal years.
*It could not be 100 per cent verified that lead parameters for "source" were not the result of leaching from taps or plumbing lines.

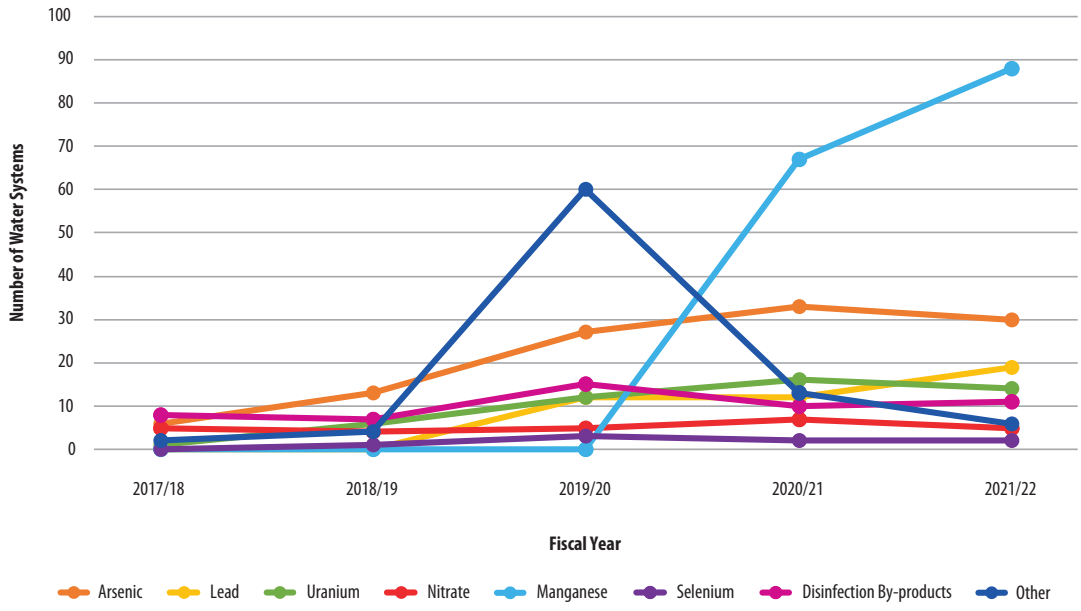
Source: Regional health authorities, 2017/18–2021/22.

Figure 6.1: Total Number of Water Systems Exceeding the Guidelines for Canadian Drinking Water Quality, At Source, BC, 2017/18 to 2021/22



Note: The maximum acceptable concentration for manganese changed in 2019, which caused existing high levels of manganese to become exceedances in the following years.
Source: Regional health authorities, 2017/18–2021/22.

Figure 6.2: Total Number of Water Systems Exceeding the Guidelines for Canadian Drinking Water Quality, Delivered to the Tap, BC, 2017/18 to 2021/22



Note: The maximum acceptable concentration for manganese changed in 2019, which caused existing high levels of manganese to become exceedances in the following years.
Source: Regional health authorities, 2017/18–2021/22.

There were unusually high "source" exceedances for lead in 2019/20, 2020/21, and 2021/22. While it is possible for lead to be present in source waters, it is not typically a widespread occurrence. In those three fiscal years, Northern Health reported the exceedances but was unable to accurately determine if they were the result of naturally occurring lead or were due to lead leaching from taps where the samples were collected. The data are presented as they were reported, but with the caveat that they may not be completely representative of source conditions.

Parameters that are included in the "disinfection by-products" and "other" categories are trihalomethanes, haloacetic acids, fluoride, boron, iron, barium, strontium, and sodium. Over the 2017/18 to 2021/22 fiscal years, the concentration of approximately 51 per cent of those parameters was reduced by treatment prior to delivery at the tap. This could be due to improvements in filtration and treatment at water treatment plants or to the selection of different water sources.

When an exceedance of the *Guidelines for Canadian Drinking Water Quality* occurs, the DWO has the discretion to determine what actions should be taken. As stated in the *Drinking Water Officers' Guide* – Part B: Section 1, actions to manage a minor exceedance can include:

- 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.[16]

The *Drinking Water Officers' Guide* also includes a decision tree to guide the DWO through a decision-making process for determining if there is sufficient evidence to support the requirement to test for additional parameters in a specific water source. If a significant exceedance occurs, a DWO will, based on the available evidence, determine the level of acceptable risk and issue an appropriate public health response.[16]

If there is a guideline exceedance, a DWO can also issue a drinking water advisory—typically a water quality advisory (WQA) or a do not use (DNU) or do not consume (DNC) notice.[b] These advisory types are uncommon; however, based on the "new notifications issued during fiscal year" category for advisories, 52 WQAs and 23 DNUs were issued for chemical exceedances from 2018/19 to 2021/22.

6.3 Approved Laboratories and Testing

6.3.1 Laboratory Approvals

Section 8(4) of the DWPR requires laboratories that conduct water quality monitoring for *E. coli* and total coliform in drinking water to be approved in writing by the PHO.[15] For the fiscal year ending on March 31, 2022, 18 PHO-approved laboratories were available for testing *E. coli* and total coliform in water. This was an increase of approximately 13 per cent since March 31, 2017. These laboratories are reviewed and recommended to the PHO by technical experts in the Enhanced Water Quality Assurance (EWQA) Program.[c] Currently, the approved laboratories include:

- One provincial/reference laboratory – BC Centre for Disease Control Public Health Laboratory (BCCDC PHL);
- Three municipal laboratories – Capital Regional District Water Services Laboratory, Metro Vancouver Water Laboratory, and City of Kelowna Water Laboratory; and
- 14 private laboratories – 13 distributed across the five regional health authorities, and one in Alberta.[17]

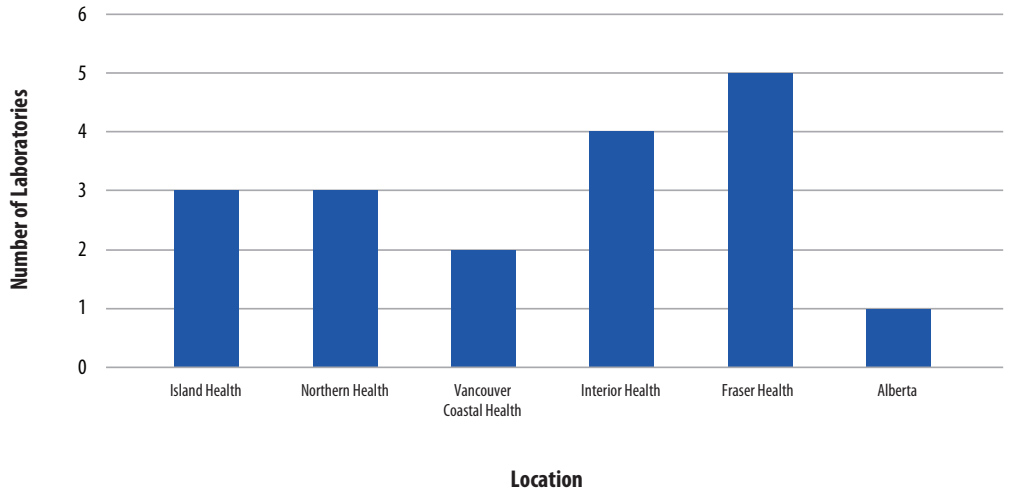
[b] Do not consume notices are included in the counts of Do not use notices in this report.

[c] The Enhanced Water Quality Assurance Program also conducts onsite laboratory inspections and audits for drinking water laboratories that use a peer-auditor inspection model, and provides educational materials, workshops, and consultation services to laboratories to improve the quality of water testing.

Figure 6.3 shows the distribution of approved laboratories across the regions; most are located in the Fraser Health region. Since the previous PHO drinking water report was released in 2019, the Northern Health region experienced the most change, gaining two approved laboratories, and the pending laboratory within Interior Health (City of Kelowna) was approved.

While the number of approved labs in BC is increasing, several remote areas of the province continue to face geographic and logistical barriers to accessing an approved lab. These challenges include meeting delivery times to get samples to a lab within the required time frame and having limited to no courier options in some northern areas of BC. Point-of-use testing (POUT) can provide an alternative to sending water samples to laboratories for analysis if the samples cannot be delivered within the 30-hour time limit required for water quality testing. Water systems that do not have in-house testing rely on courier companies to transport their water samples; therefore, any changes to routes or overnight shipping capability (such as flight cancellations during the pandemic and other emergencies) will affect whether a water sample can be tested. As such, POUT is an option for potentially reducing sample wastage and minimizing impacts from transporting samples over long distances (see text box on next page for more detail). In an effort to address the limited access to laboratory testing in rural and remote areas of the province, the BCCDC PHL launched a POUT pilot in two locations within the Northern Health region. The pilots involved planning and coordinating the establishment of POUT at select locations, in addition to providing training and consultation for staff.[18] Unfortunately, the pilots were discontinued in 2020 when COVID-19 redeployments and staff vacancies at participating health units made the pilots no longer feasible.[19] Although the pilots did not have the longevity hoped for, the project demonstrated the importance of having dedicated and trained staff in areas where POUT is considered as an alternative solution to laboratory testing.

Figure 6.3: Number of Provincial Health Officer-Approved Laboratories, by Region, 2022



Note: Approved laboratories have been approved in writing by the Provincial Health Officer, per section 8(4) of the Drinking Water Protection Regulation.

Source: Enhanced Water Quality Assurance Program; 2022.

Point-of-use testing (POUT)

BC is geographically large, and many water systems or suppliers are in remote and/or challenging locations. This can cause issues in meeting the 30-hour time limit for water quality testing at the BC Centre for Disease Control Public Health Laboratory (BCCDC PHL) or at one of the subcontracted laboratories. The following are some of the challenges that water suppliers face:

- Sampling locations
  - Difficult to access areas
  - Sampling location is far from a lab
- Courier/transportation issues
  - Lack of local courier/flight options
  - Water samples lost in transit
- Unexpected events, such as flooding, drought, and wildfires
  - Highway closures that prevent samples from being delivered to an approved lab
  - Contamination of water sources which requires additional sampling

One potential solution that has been proposed to address these issues is point-of-use testing (POUT). It uses specialized technical equipment to test water samples for total coliform and *E. coli*. These tests could be conducted at non-laboratory locations, such as health units or other community locations, and the analysis would be performed by a trained individual. The testing location would be selected and agreed upon by the Provincial Health Officer (PHO), the respective regional health authority, and the BCCDC PHL. These locations would be appropriately placed in areas where time and/or transportation challenges have been identified. Program evaluation and quality assurance would be overseen by the Enhanced Water Quality Assurance Program.

Using POUT in remote locations would meet Recommendation 27 of the 2019 PHO drinking water report. That recommendation targets the development of a strategic approach to supporting improved access to water testing for microbiological indicators in remote and rural areas, which would include POUT.[10] An update to Recommendation 27 is provided in Chapter 11 of this report.

A laboratory technologist from the BC Centre for Disease Control Public Health Laboratory pouring a water sample mixed with the point-of-use testing Colilert reagent into a QuantiTray (left). This allows the water to be partitioned into many wells so that total coliform and *E.coli* can be enumerated. The laboratory technologist then checks the Colilert control plate from the QuantiTray. Yellow indicates that total coliform are present. Further confirmation using ultraviolet light on this tray confirms if fluorescing total coliform detected are *E. coli* (as depicted in this positive control).

Photo credit: BC Centre for Disease Control Public Health Laboratory.

6.3.2 Laboratory Audits

As part of the approval process, laboratories must submit various documents to EWQA and pass an onsite audit. EWQA verifies if a laboratory's drinking water testing methods and its space, staff, equipment, and operating procedures conform to EWQA audit standards and the DWPA and DWPR.[20] Laboratories that pass the approval process receive a certificate from the PHO, which is valid for three years. Ongoing laboratory certification requires satisfactory performance with external proficiency testing twice a year, a mid-cycle self-assessment, and an onsite audit.[21]

In response to the pandemic, EWQA cancelled all onsite laboratory audits in 2020 and offered virtual audits to maintain the program (see Chapter 9 of this report). *Table 6.5* shows the number of audits completed by EWQA. Four audits were completed in 2021; another four were completed in 2022. Onsite audits resumed in June 2022.

Table 6.5: Number of Audits of Provincial Health Officer-Approved Laboratories, BC, 2021 and 2022

Laboratory	City	Audit Dates
Caro Analytical Services	Richmond	February 25–26, 2021 (virtual audit)
City of Kelowna Drinking Water Laboratory	Kelowna	May 31 & June 1, 2021 (virtual audit)
Caro Analytical Services	Kelowna	June 14 & 15, 2021 (virtual audit)
Passmore Laboratory Ltd	Winlaw	June 17 & 18, 2021 (virtual audit)
Bureau Veritas	Burnaby	April 28 & 29, 2022 (virtual audit)
BC Center for Disease Control Public Health Laboratory	Vancouver	March 21 & 22, 2022 (virtual audit)
ALS Environmental	Calgary	April 25 & 26, 2022 (virtual audit)
Wellness Water Testing Laboratory Ltd	Prince George	May 30 & 31, 2022 (virtual audit)
Northern Laboratories (2010) Ltd	Prince Rupert	June 10, 2022 (onsite audit)
Metro Vancouver Microbiology Laboratory	Burnaby	September 22, 2022 (onsite audit)
Bureau Veritas	Courtenay	August 26, 2022 (onsite audit)

Source: BC Centre for Disease Control Public Health Laboratory; 2021–2022.

6.3.3 Laboratory Testing

Drinking water legislation requires water suppliers to submit water samples for total coliform and *E. coli* testing at frequencies set out in the DWPR.[15] The laboratory conducting the tests must notify the water supplier, the drinking water officer, and the medical health officer if any monitored parameter fails to meet the standard. *Table 6.6* shows the number of water samples submitted to laboratories for testing, by fiscal year, and how many were positive for *E. coli*. Data are available only for BCCDC PHL or BCCDC PHL sub-contracted labs (CARO Analytical Services – Kelowna, Northern Laboratories Ltd and Wellness Water Testing Laboratory Inc.). The BCCDC PHL added Wellness Water Testing Laboratory Inc. as a sub-contracted lab in 2020/2021 to alleviate the additional transportation and courier challenges brought on by the pandemic.[22] Sub-contracted labs are described in the text box below.

BC Centre for Disease Control Public Health Laboratory (BCCDC PHL) Sub-contracted Labs

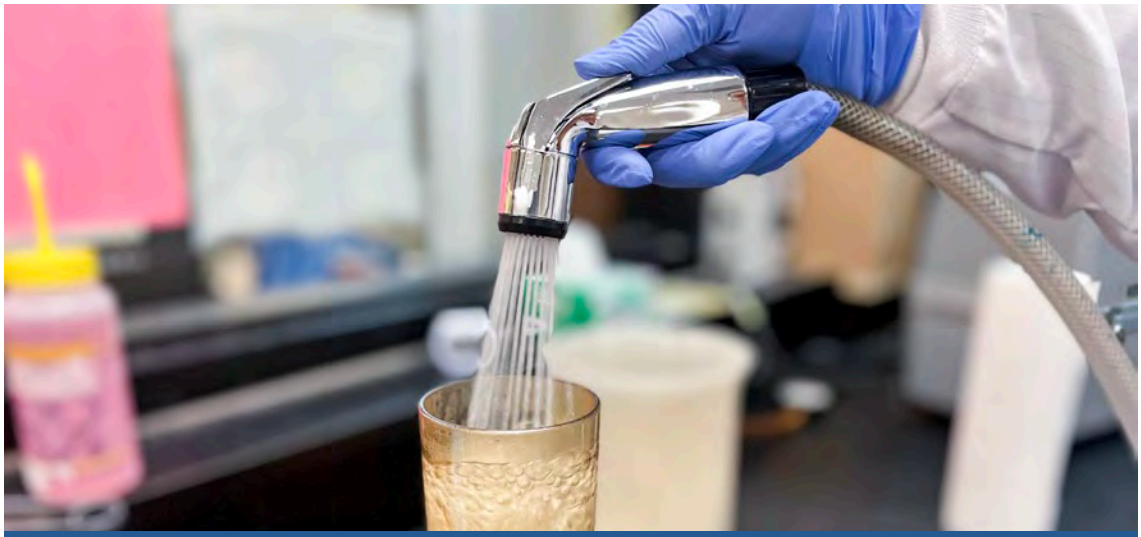
The BCCDC PHL supports public small and medium-sized water systems by providing subsidized routine bacterial water quality testing for total coliform and *E. coli*, as required under the *Drinking Water Protection Act* and regulation. This service includes arranging and paying for samples to be shipped to the BCCDC PHL for testing. However, the BCCDC PHL is limited in how much it can support these systems due to:

- Geography – The BCCDC PHL is located in Vancouver, and is often challenged to meet the requirement of testing samples within 30 hours of being collected.
- Capacity – Although the Environmental Microbiology section within the BCCDC PHL is a dedicated part of the facility, it has limited infrastructure to support onsite testing for all small and medium-sized water systems due to volume.

Therefore, the BCCDC PHL must subcontract a portion of testing in BC in order to meet provincial water testing demands.

Sub-contracted labs provide routine testing for total coliform and *E. coli* in samples from public small and medium-sized water systems. On request, the labs may perform additional testing contingent on BCCDC PHL approval and health authority consultation. These labs typically have a limited scope of testing methodologies compared to the BCCDC PHL, which is a reference laboratory that is capable of conducting routine and enhanced testing, and has proficiency and competency in many water testing methodologies that are approved by the Provincial Health Officer.

The current sub-contracted labs in BC include CARO Analytical Services in Kelowna, Northern Laboratories (2010) Ltd in Prince Rupert, and Wellness Water Testing Laboratory Inc. in Prince George.



A Laboratory Technologist from the BC Centre for Disease Control Public Health Laboratory is processing drinking water using the membrane filtration technique. This is a provincially approved testing method for drinking water microbiological analysis. Quality assurance practices, such as aseptic technique, buffer washes, and other quality control measures are required to ensure test result reliability.

Photo credit: BC Centre for Disease Control Public Health Laboratory.

In 2017, BCCDC PHL sub-contracted laboratories began reporting to the PHO the number of water samples received and tested for the required parameters. These laboratories received, on average, 17,601 water samples per year, or approximately 20 per cent of all samples submitted for analysis (*Table 6.6*). Sampling data from private approved labs are not available to the PHO at this time.

The number of water samples sent to the BCCDC PHL and sub-contracted labs has remained relatively consistent over time, varying by 1–3 per cent year to year, except for the 2020/21 and 2021/22 fiscal years, when submissions decreased by 13 and 11 per cent, respectively, from the high in 2019/20. The end of the calendar year is typically a challenging time to meet the 30-hour time limit for water testing, and the impacts of the COVID-19 pandemic may have exacerbated the problem in 2020/21. As a result, water sample testing for December 2020 decreased by 74 per cent compared to the yearly average. For the 2021/22 fiscal year, water sample testing increased compared to 2020/21 but was still less than pre-pandemic levels. Overall, positive *E. coli* samples remained stable from 2017/18 to 2021/22, although there were slight variations year to year (*Table 6.6*).

Information on why samples were wasted is not available, but most often this is due to failure to meet the 30-hour time limit for testing, improper shipping and handling, or incorrect sample labelling. The number of wasted samples was relatively stable from 2017/18 to 2019/20, but in 2020/21 and 2021/22, the number increased by 21 and 46 per cent, respectively (*Table 6.6*).

Table 6.6: Number of Water Samples Submitted, and Number and Percentage of Wasted Samples and Positive *E. coli* Reports, BC, 2017/18 to 2021/22

Fiscal Year	Reporting Laboratory	Samples Submitted	Samples Wasted	Positive *E. coli* Reports
2017/18	BC Centre for Disease Control Public Health Laboratory	73,402	1,094 (1.49%)	189 (0.26%)
	CARO Analytical Services - Kelowna	11,724	0	14 (0.12%)
	Northern Laboratories (2010) Ltd	3,819	0	17 (0.45%)
	Total	**88,945**	**1,094 (1.23%)**	**220 (0.25%)**
2018/19	BC Centre for Disease Control Public Health Laboratory	72,544	971 (1.34%)	200 (0.26%)
	CARO Analytical Services - Kelowna	12,710	0	21 (0.17%)
	Northern Laboratories (2010) Ltd	3,576	2 (0.06%)	17 (0.48%)
	Total	**88,830**	**973 (1.10%)**	**238 (0.27%)**
2019/20	BC Centre for Disease Control Public Health Laboratory	74,818	904 (1.21%)	192 (0.26%)
	CARO Analytical Services - Kelowna	13,000	0	18 (0.14%)
	Northern Laboratories (2010) Ltd	3,745	34 (0.91%)	26 (0.69%)
	Total	**91,563**	**938 (1.02%)**	**236 (0.26%)**
2020/21	BC Centre for Disease Control Public Health Laboratory	65,038	1,113 (1.71%)	137 (0.21%)
	CARO Analytical Services - Kelowna	12,183	59 (0.48%)	16 (0.13%)
	Northern Laboratories (2010) Ltd	3,725	36 (0.97%)	35 (0.94%)
	Wellness Water Testing Laboratory Inc.	1,790	0	8 (0.45%)
	Total	**82,736**	**1,208 (1.46%)**	**196 (0.24%)**
2021/22	BC Centre for Disease Control Public Health Laboratory	66,385	776 (1.17%)	126 (0.19%)
	CARO Analytical Services - Kelowna	16,691	641 (3.84%)	12 (0.07%)
	Northern Laboratories (2010) Ltd	4,016	47 (1.17%)	30 (0.75%)
	Wellness Water Testing Laboratory Inc.	1,027	0	13 (1.27%)
	Total	**88,119**	**1,464 (1.66%)**	**181 (0.21%)**

Note: Only positive *E. coli* drinking water samples are presented. Untreated source water samples are not included. A sample is considered wasted if analysis of the sample does not begin within 30 hours of the sample being collected.

Source: BC Centre for Disease Control Public Health Laboratory; 2017/18–2021/22.

Courier disruptions and flight cancellations due to the effects of COVID-19 on the transportation network in BC likely contributed to this increase. Furthermore, the large increase in 2021/22 corresponded with an atmospheric river weather event and flooding, which caused considerable further disturbances to the sample distribution network.

6.4 Annual Water Supply System Reports

Under the DWPA (section 15) and the DWPR (section 11), water suppliers are required to prepare and make public an annual report[12,15] that includes the results of monitoring required by the legislation, the operating permit, or the DWO. Other information that must be reported and made public under section 15 of the DWPA includes the water supplier's emergency response and contingency plan, any assessments or plans made under section 18 and 22 of the Act, if applicable, or any other information that is required by the operating permit or the DWO.

As part of the multi-barrier approach, the previous PHO drinking water report identified compliance with annual reporting requirements as a future indicator of reporting.[10] At that time, only Fraser Health tracked compliance with annual reporting requirements in their data system; however, Island Health and Interior Health are now also tracking their compliance.

Table 6.7 shows the number and percentage of water systems that prepared their annual report and made it publicly available within six months of the end of the calendar year in 2019/20 and 2021/22. Compliance rates for annual reporting within Fraser Health in 2019/20 were high, whereas the rates within Island Health and Interior Health were much lower. Underreporting in these regions may have occurred because the new indicator would not have been previously recorded within their data systems. Due to limitations with their data systems, complete data on this indicator were not available for Northern Health, Vancouver Coastal Health, and Fraser Health for 2019/20 and/or 2021/22. Data on this indicator were not collected from any of the regional health authorities for the 2020/21 fiscal year due to resourcing limitations as a result of the COVID-19 pandemic. Collection of data on this indicator resumed in 2021/22; however, the data request was reframed to determine compliance rates for community water systems only. As a result of limiting the data to community water systems, compliance increased for Interior Health, whereas it decreased for Island Health. In both 2019/20 and 2021/22, compliance was greater for large water systems than for small water systems.

Table 6.7: Number and Percentage of Small and Large Water Systems Preparing an Annual Report, BC, 2019/20 and 2021/22

Regional Health Authority	2019/20			2021/22 – Community Water Systems Only		
	Small	Large	Total	Small	Large	Total
Island Health	208 (23%)	45 (51%)	**253 (26%)**	58 (22%)	25 (35%)	**83 (25%)**
Vancouver Coastal Health	–	–	**–**	70 (44%)	22 (79%)	**92 (49%)**
Interior Health	415 (23%)	52 (34%)	**467 (24%)**	469 (66%)	43 (72%)	**512 (66%)**
Fraser Health	370 (90%)	39 (100%)	**409 (91%)**	–	–	**–**

Note: Data are not available from Northern Health. Data were not available from Vancouver Coastal Health for 2019/20. Data from all health authorities were not requested for 2020/21 due to data system limitations or resource limitations as a result of the COVID-19 pandemic response. Data for 2021/22 are presented for community water systems only and do not include stand-alone systems. Data were not available from Fraser Health for 2021/22.

Source: Regional health authorities; 2019/20–2021/22.

6.5 Waterborne Disease Surveillance

The Communicable Disease Regulation under the *Public Health Act* requires physicians and laboratories to report all known or suspected cases of waterborne illness to the regional medical health officer.[23] Public health officials may then collect information from reported or suspected cases to determine the type of food and water that was consumed, if there had been contact with animals or ill people, or if travel outside the country had occurred, which is then reported to the BC Centre for Disease Control (BCCDC) by the medical health officer.

Table 6.8 shows the number of reported cases of enteric disease in BC from 2017 to 2019 (data for 2020 or later were not available at the time of writing). People living in BC at that time were regularly affected by disease that may have been caused by a waterborne pathogen such as *Campylobacter,* shigatoxigenic *E. coli, Cryptosporidium, Giardia,* or non-typhoidal *Salmonella*. *Campylobacter* infections accounted for 49 per cent of the total reported cases of enteric disease, while *Salmonella* and *Giardia* contributed 27 and 17 per cent, respectively. Reported cases of *E. coli* and *Cryptosporidium* were each less than 5 per cent.

From 2007 to 2019, the overall annual rate of enteric diseases reported by the BCCDC remained relatively stable (*Figure 6.4*). Despite an increase in reported cases of campylobacteriosis in 2009, 2012, and 2017, the rate had decreased by 18 per cent since 2007. In 2019, rates of both giardiasis and cryptosporidiosis increased, possibly due to out-of-country travel-related reasons. However, both parasites are known to be resistant to chlorine,[25,26] which may allow them to survive in chlorinated drinking water unless water suppliers use additional treatment and/or filtration.

From 2017 to 2021, there was only one reported outbreak of a drinking water-related illness in BC, which occurred in 2017 at a remote lodge in Yoho National Park, where astrovirus was confirmed. The outbreak occurred when the drinking water source for the park water supply system became contaminated following a septic system line break. Five cases of gastrointestinal illness were reported, and there were anecdotal reports of several additional cases.[27] Interior Health responded to the outbreak, but because the drinking water for the facility is under federal jurisdiction,[d] the water system is not permitted or inspected under the DWPA by the health authority. However, under the *Public Health Act*, the health authority permits and inspects food facilities and swimming pools in national parks and federal buildings. This confusing patchwork of responsibility for environmental health services on federal lands can result in a lack of oversight for drinking water, which may lead to increased potential for, and risk of, outbreaks of a drinking water-related illness.

Table 6.8: Cases of Enteric Disease Reported to the BC Centre for Disease Control, BC, 2017 to 2019

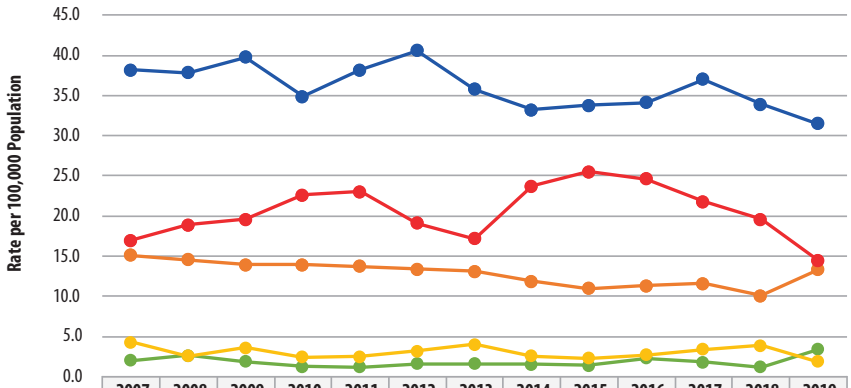
Enteric Disease	2017	2018	2019
Campylobacteriosis	1,825	1,699	1,602
Giardiasis	571	507	678
Cryptosporidiosis	88	61	172
Shigatoxigenic *E.coli* infection	169	193	97
Salmonellosis (non-typhoidal)	1,073	981	736
Total	**3,726**	**3,441**	**3,285**

Note: Disease rates reflect reported laboratory confirmed cases, and do not differentiate between cases that were acquired from drinking water and those acquired through other routes of exposure, such as food. Data beyond 2019 were not available from the BCCDC at the time of writing.

Source: BC Centre for Disease Control; 2019.[24]

[d] Guidance for providing safe drinking water in areas of federal jurisdiction: *https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-providing-safe-drinking-water-areas-federal-jurisdiction-version-3.html#a1.2*

Figure 6.4: Incidence Rates of Enteric Diseases Reported from the BC Centre for Disease Control, by Year, BC, 2007 to 2019



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Campylobacteriosis	38.2	37.8	39.8	34.9	38.2	40.6	35.8	33.2	33.8	34.1	37	33.9	31.5
Giardiasis	15.1	14.6	13.9	14.0	13.7	13.4	13.1	11.9	11.0	11.3	11.6	10.1	13.3
Cryptosporidiosis	2.1	2.6	1.9	1.2	1.2	1.6	1.6	1.6	1.4	2.3	1.8	1.2	3.4
Shigatoxigenic *E.coli* Infection	4.3	2.6	3.6	2.4	2.5	3.2	4.0	2.6	2.3	2.7	3.4	3.9	1.9
Salmonellosis (non-typhoidal)	17.0	18.9	19.6	22.6	23.0	19.1	17.2	23.7	25.5	24.6	21.8	19.6	14.5

Year

Note: Disease rates reflect reported laboratory confirmed cases, and do not differentiate between cases that were acquired from drinking water and those acquired through other routes of exposure, such as food. Data beyond 2019 were not available at the time of writing.

Source: BC Centre for Disease Control; 2019.

6.6 First Nations Drinking Water Quality

As described in Chapter 2 of this report, the First Nations Health Authority (FNHA) works in partnership with First Nations communities through the Drinking Water Safety Program to support access to safe and reliable drinking water within their communities. The Drinking Water Safety Program, which adheres to the *Guidelines for Canadian Drinking Water Quality*,[3] is a core part of Environmental Public Health Services that identifies, prevents, and works to mitigate public health risks in First Nations communities.[28]

During fiscal years 2017 through 2022, a total of 166,018 microbiological samples from all First Nations water systems in BC were analyzed (*Table 6.9*). Approximately 96 per cent of all samples tested for bacteriological parameters were satisfactory, 4 per cent were positive for total coliform, and fewer than half of 1 per cent (0.4 per cent) were positive for *E. coli*.[28]

Table 6.9: First Nations Health Authority Microbiological Water Quality Testing, BC, 2017/18 to 2021/22

Category	2017/18	2018/19	2019/20	2020/21	2021/22
Number of Positive Samples for Total Coliform	1,684	1,375	1,187	835	904
Number of Positive Samples for *E. coli*	243	160	147	60	34
Total Number of Samples Tested (i.e., Total Coliform and *E. coli*)	38,373	36,014	33,946	27,303	30,382

Source: First Nations Health Authority; 2017/18–2021/22.

From April 2017 to March 2022, more than 16,000 comprehensive chemical samples were tested from all water systems. Sample sets included physical and chemical parameters, metals, or a specific subset of these (i.e., metals only). Of these samples, 99 per cent had satisfactory results and met guideline levels; less than half of 1 per cent (1,286) of the parameters/analytes sampled exceeded the MAC according to the *Guidelines for Canadian Drinking Water Quality* (*Table 6.10*). Multiple exceedances can occur due to repeat sampling while troubleshooting water system/quality concerns, or as a result of seasonal variations; therefore, they are not always indicative of a health risk. When an exceedance of a guideline level occurred, drinking water risk advice was provided, and/or advisories were recommended.[27] In 2018/19, there were more samples with elevated lead exceedances compared to other fiscal years because FNHA conducted an extensive lead sampling campaign (approximately four to five times as many samples testing for lead levels were collected), and the Health Canada lead guideline changed partway through the year.[28]

All community water systems and public water systems are sampled yearly for comprehensive general chemistry and physical parameters, and metals to ensure compliance with the *Guidelines for Canadian Drinking Water Quality*.[28]

In addition to regular sampling in communities, the community may request and/or FNHA may recommend that special project sampling be conducted to monitor, for example, cyanobacteria, nitrates, or impacts from the land application of biosolids. FNHA also conducts lead and copper (complete metals) sampling of drinking water in all school and daycare facilities on reserve; extensive sampling was conducted in 2018 and again in 2019. FNHA began a third round of lead and copper sampling in 2021, which focused on drinking and food-preparation locations in schools and daycares.[28]

Claudette Leon, a community-based water monitor from the Sts'ailes Nation, testing for disinfection by-products.

Photo credit: First Nations Health Authority.

Table 6.10: First Nations Health Authority Guidelines for Canadian Drinking Water Quality (GCDWQ) Testing Results, BC, 2017/18 to 2021/22

Number of Exceedances of a GCDWQ Maximum Acceptable Concentration (MAC)	2017/18	2018/19	2019/20	2020/21	2021/22
Copper MAC Exceedances (2 mg/L after June 1, 2019)	0	0	8	11	44
Lead MAC Exceedances (0.01 mg/L before March 8, 2019; 0.005 mg/L after March 8, 2019)	14	223	30	24	182
Manganese MAC Exceedances (0.12 mg/L after May 10, 2019)	0	0	73	46	73
Total Number of MAC Exceedances - All Parameters	129	370	202	125	460

Note: Some of the GCDWQ exceedances were multiples from one sample set. The data include results from sampling in schools and daycare facilities on reserve.

Source: First Nations Health Authority; 2017/18–2021/22.

6.7 Public Notification of Drinking Water Quality Concerns

6.7.1. Drinking Water Advisories under the *Drinking Water Protection Act*

Under the DWPA, if a prescribed water quality standard is not met or the water supplier believes there is a threat to the drinking water, they must notify the drinking water officer. The officer may request or order the water supplier to give public notice of the potential threat and recommend what actions should be taken by the system users.[12]

A drinking water advisory is an important tool in public health risk management. Advisories communicate risk to the public and offer advice when conditions could expose individuals to health threats from their drinking water supply. While outbreaks of waterborne illness in Canada are rare, infections stemming from contaminated water supplies can result in serious health consequences, especially in the very young, the elderly, or those with compromised immune systems. In BC, water from lakes, streams, or underground sources may also carry pathogens such as bacteria, viruses, or parasites (including *Giardia, Cryptosporidium, Campylobacter*).[29] These pathogens can cause a range of illnesses from mild cases of diarrhea to severe infections, which sometimes results in hospitalizations, secondary infections, complications (e.g., haemolytic uremic syndrome), chronic diseases, or death.[30]

Officials issue a drinking water advisory in emergencies (such as bacteriological contamination, disruption of treatment, or disinfection failure) or as an administrative precaution when water supplies lack adequate treatment to protect users from potential microbial contamination. The advisories, which may be system wide or site specific, warn users and advise them to boil their water or use bottled water to avoid becoming ill from their drinking water supply.[31] The other types of drinking water advisories may warn certain vulnerable populations when risks from microbiological or chemical agents are modest or affect only certain groups (that are at a greater risk), or may inform users not to consume their water when boiling it cannot remediate an identified contaminant. BC uses three levels of drinking water advisories:

A sign at the entrance to the Krestova Improvement District in the Slocan valley that informs residents and visitors to the community of the boil water notice that has been in effect since 1992. The improvement district relies on untreated water from a creek.

Photo credit: Greg Baytalan, Environmental Public Health, Interior Health.

Water Quality Advisory – used when there is some level of risk but a boil water notice or do not use water notice is not required. This advisory is often used when systems are experiencing dirty or turbid water during flushing of lines, or to provide advice to target populations that may need to take extra precautions when certain parameters are present. The advisory will include what the risk is, what the supplier is doing to address the risk, and what the users can do to minimize their risk.

Boil Water Notice – used when there is a health risk from consuming the water, and the risk can be addressed by boiling the water. The notice will give specific instructions on how long the water must be boiled, and what the supplier is doing to address the risks.

Do Not Use Water Notice – used where there is a health risk from using or consuming the water and boiling the water will not address the risk. This type of notice may be used where health parameters exceed the maximum allowable limits or there has been an incident of vandalism, a chemical spill, or a natural event such as a flood. In some cases, the water may be used for hygienic purposes (e.g., bathing, showering, handwashing) but not consumption. This is called a "Do Not Consume Notice" but is captured within the same category as "do not use" in the health authority data systems.

Table 6.11 lists the number and percentage of water systems with drinking water advisories in effect, by regional health authority, as of March 31 for 2018 to 2022. Boil water notices were the most common, followed by water quality advisories, and do not use notices.

The total number of drinking water advisories was greater than the 2017 counts (*n* = 603) reported in the previous PHO drinking water report, by a minimum of 44 in 2019 and a maximum of 200 in 2022. Over the reporting period (from April 1, 2017 to March 31, 2022), boil water

Table 6.11: Number and Percentage of Drinking Water Systems with Advisories in Effect as of March 31, by Advisory Type and Regional Health Authority, BC, 2018 to 2022

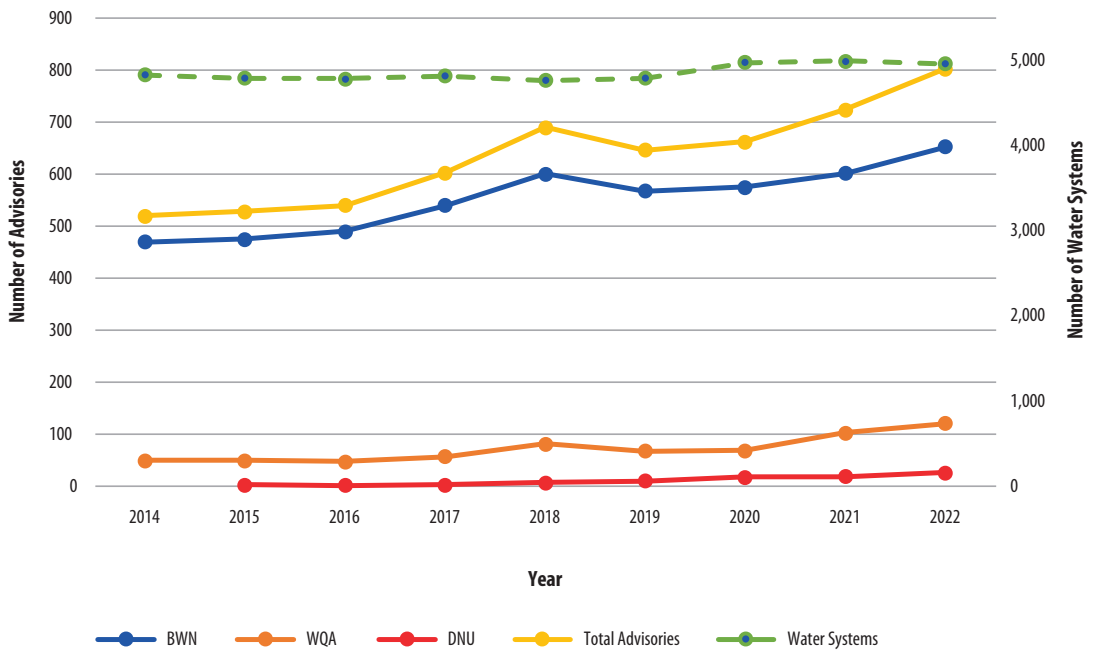
Year	Advisory Type	Island Health	Northern Health	Vancouver Coastal Health	Interior Health	Fraser Health	Totals
2018	Boil Water Notice	77 (8%)	46 (4%)	52 (15%)	421 (22%)	5 (1%)	**601 (13%)**
	Water Quality Advisory	13 (1%)	1 (1%)	0 (0%)	68 (4%)	0 (0%)	**82 (2%)**
	Do Not Use Notice	0 (0%)	1 (1%)	0 (0%)	7 (1%)	0 (0%)	**8 (1%)**
	Total	**90 (10%)**	**48 (4%)**	**52 (15%)**	**496 (26%)**	**5 (1%)**	**691 (14%)**
	Number of Water Systems	**930**	**1,139**	**348**	**1,911**	**445**	**4,773**
2019	Boil Water Notice	42 (4%)	55 (5%)	56 (16%)	409 (21%)	6 (1%)	**568 (12%)**
	Water Quality Advisory	2 (1%)	2 (1%)	0 (0%)	64 (3%)	0 (0%)	**68 (1%)**
	Do Not Use Notice	0 (0%)	1 (1%)	0 (0%)	10 (1%)	0 (0%)	**11 (1%)**
	Total	**44 (5%)**	**58 (5%)**	**56 (16%)**	**483 (25%)**	**6 (1%)**	**647 (13%)**
	Number of Water Systems	**934**	**1,139**	**351**	**1,926**	**449**	**4,799**
2020	Boil Water Notice	42 (4%)	72 (6%)	59 (16%)	396 (21%)	7 (2%)	**576 (12%)**
	Water Quality Advisory	2 (1%)	4 (1%)	0 (0%)	61 (3%)	2 (1%)	**69 (1%)**
	Do Not Use Notice	0 (0%)	2 (1%)	0 (0%)	16 (1%)	0 (0%)	**18 (1%)**
	Total	**44 (4%)**	**78 (6%)**	**59 (16%)**	**473(25%)**	**9 (2%)**	**663 (13%)**
	Number of Water Systems	**991**	**1,240**	**366**	**1,927**	**449**	**4,973**
2021	Boil Water Notice	41 (4%)	98 (8%)	50 (14%)	404 (21%)	9 (2%)	**602 (12%)**
	Water Quality Advisory	2 (1%)	22 (2%)	2 (1%)	76 (4%)	2 (1%)	**104 (2%)**
	Do Not Use Notice	0 (0%)	4 (1%)	0 (0%)	15 (1%)	0 (0%)	**19 (1%)**
	Total	**43 (4%)**	**124 (10%)**	**52 (14%)**	**495 (26%)**	**11 (3%)**	**725 (14%)**
	Number of Water Systems	**996**	**1,259**	**362**	**1,940**	**444**	**5,001**
2022	Boil Water Notice	39 (4%)	130 (10%)	52 (14%)	428 (22%)	5 (1%)	**654 (13%)**
	Water Quality Advisory	4 (1%)	26 (2%)	1 (1%)	87 (4%)	4 (1%)	**122 (3%)**
	Do Not Use Notice	0 (0%)	4 (1%)	4 (1%)	19 (1%)	0 (0%)	**27 (1%)**
	Total	**43 (5%)**	**160 (13%)**	**57 (16%)**	**534 (27%)**	**9 (2%)**	**803 (16%)**
	Number of Water Systems	**949**	**1,255**	**367**	**1,968**	**429**	**4,968**

Source: Regional health authorities; 2018–2022.

notices increased by 21 per cent, water quality advisories increased by 110 per cent, and do not use notices increased by 575 per cent. The considerable increase in water quality advisories and do not use notices occurred primarily within the Interior and Northern Health regions. Increases in the total number of advisories were especially noticeable again within Northern Health, where drinking water advisories increased by 186 per cent from 2017 to 2022.

Figure 6.5 shows the increasing trend in the number of drinking water advisories issued since 2014. The 803 total advisories recorded as of March 31, 2022 was the highest number ever recorded, and indicates that 16 per cent of the 4,968 water systems in BC were on an advisory at that time (*Table 6.11*). Compared to the total number of advisories previously reported for March 31, 2017,[10] the total number for March 31, 2022 increased by 33 per cent. Across all advisory types, increases were noted for each year following 2018. The number of boil water notices (BWNs) in 2021 was similar to the previous high in 2018; however, the number of WQAs and DNUs in 2021 was higher than that in 2018. In 2022, the increase in the number of all advisory types continued. The total number of advisories increased by 11 per cent, BWNs by 9 per cent, WQAs by 17 per cent, and DNUs by 42 per cent from 2021 to 2022. It should be noted that the total number of systems across the province has increased slightly most years; however, those changes are marginal and do not appear to be a main driver of the recent increase in the number of advisories issued. In 2017, 12 per cent of water systems had been issued an advisory; in 2018, 14 per cent were on advisory. From 2018 to 2021, the percentage of systems on advisory remained relatively consistent, but a notable increase from 14 per cent to 16 per cent occurred again in 2022.

Figure 6.5: Total Number of Drinking Water Advisories and Drinking Water Systems on March 31, by Advisory Type and Year, BC, 2014 to 2022



Note: BWN = boil water notice; WQA = water quality advisory; DNU = do not use notice. Total advisories is the sum of all advisories for that fiscal year. "Do not use" data were not available for the 2014 year.

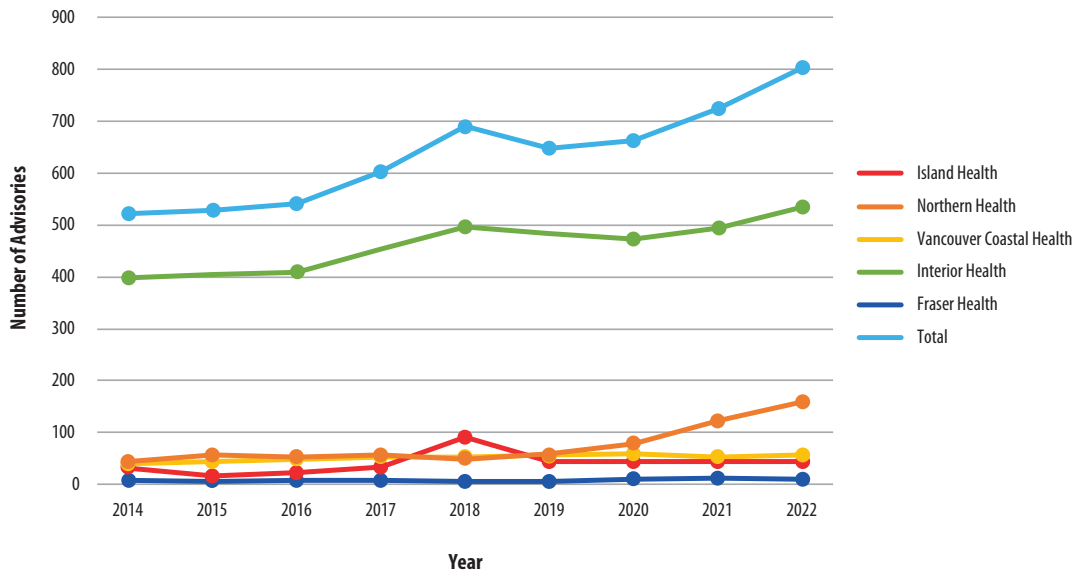
Source: PHO 2019 drinking water report; regional health authorities; 2018–2022.

Figure 6.6 shows that from 2014 to 2022, most of the advisories (up to 68 per cent) occurred in the Interior Health region, although there was an increasing trend in Northern Health over the past few years (up 20 per cent as of 2022). Both regions have a large number of small water systems which face significant operational, financial, and governance challenges in providing potable water to their users. Many of these systems are in remote areas of the province, which adds to the challenges they face. As a result, water quality challenges and regulatory non-compliance are more likely to occur among small water systems.

An increase in WQAs related to elevated manganese since the introduction of the new health-based guideline in 2019 (Section 6.2.2) also occurred, particularly in Northern Health, where many systems with elevated manganese are located. As a result of the guideline change, Northern Health systematically contacted water suppliers who had sample data that exceeded the new MAC for manganese and directed them to advise their water users to prepare powdered formula for bottle-fed infants with an alternative source of potable water until improvements could be made to the system to reduce manganese levels.[32] Also, drinking water officials found that water suppliers who were in exceedance of the new MAC were confused about the revised guideline, and the DWOs received questions from users about the health implications of the exceedances, which highlights the need for an effective communication and rollout plan when significant guideline changes or introductions occur.

As was noted in the previous report, the advisories reported in *Table 6.11, Figure 6.5,* and *Figure 6.6* reflect a snapshot in time rather than fluctuations in the number of short-term advisories issued during the year, and they do not account for the reason for the advisory. Therefore, the ability to draw conclusions about the increases in the number of advisories issued is limited. However, the increasing capacity challenges of small water systems and the impacts of climate change and extreme weather events are believed to be contributing to the growing trend and fluctuations in the number of advisories issued from year to year. For example, wildfires in 2017 and 2018 set records in terms of the number of fires and the amount of area burned, and displaced many British Columbians and cost hundreds of millions of

Figure 6.6: Number of Total Drinking Water Advisories in Effect as of March 31, by Regional Health Authority, BC, 2014 to 2022



Source: Regional health authorities; 2014–2022.

(Above) Fire damage at the Rose Valley Lake reservoir in West Kelowna after the 2023 McDougall Creek wildfire. (Top right) A landslide caused by an atmospheric river in the Fraser Valley, November 2021.

Photo credits: (Bottom) City of West Kelowna; (Top right) Ministry of Emergency Management and Climate Readiness.

dollars in fire suppression efforts.[33] Additionally, in 2017, spring storms caused creeks and rivers to spill their banks, which caused flooding and affected communities in the Thompson Okanagan region.[34] The province faced a severe wildfire season again in 2021, which at its height included more than 300 active wildfires, and was coupled with the effects of the COVID-19 pandemic and the historic "heat dome" in late June and early July.[33] In late 2021, an atmospheric river weather event brought significant amounts of precipitation and caused flooding in the Lower Mainland, Merritt, and Princeton (see Chapter 10, Section 10.1.1). The flooding displaced many residents of these areas, impacted much of the critical infrastructure related to drinking water, inundated wells with surface water runoff, and required local regional health authorities to issue BWNs and DNU/DNCs for specific areas.[35] Events such as these can affect drinking water quality by altering source water conditions and impairing water system treatment efficacy, which can lead to microbiological counts. The elevated number of drinking water advisories issued in 2018, 2021, and 2022 (*Figure 6.6*) may have been a result of such events.

The previous PHO drinking water report discussed the limitations of drinking water advisory information received from regional health authorities.[10] In the past, the reason(s) for issuing a drinking water advisory were not collected by the regional health authorities. However, the PHO has been working with them to integrate this information into their data systems. A preliminary summary of that limited data set is presented here.

Table 6.12 shows the reasons why drinking water advisories were issued, and the number of times those reasons were cited in an advisory during the 2018/19 to 2021/22 fiscal years. In each of those fiscal years, 630, 597, 766, and 904 reasons for issuing a drinking water advisory were recorded, respectively. Untreated water at risk of containing pathogens was the most common reason for issuing an advisory, followed by unacceptable water quality results. Source water deterioration, insufficient treatment, water quality parameter exceedances, and inadequate operations and maintenance were other common reasons for issuing a drinking water advisory. As mentioned, these data are presented in limited form because they do not account for uncategorized drinking water advisories, nor are they a complete representation of all advisories issued by regional health authorities. In 2017/18, the PHO began collecting data on

Table 6.12: Reasons for Drinking Water Advisories in Effect for All Regional Health Authorities, BC, 2018/19 to 2021/22

Advisory Reason	2018/19		2019/20		2020/21		2021/22	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Source Water Quality Deterioration or Contamination	62	9.84%	55	9.21%	62	8.09%	71	7.85%
Unapproved Water Supply System or Construction Works	25	3.97%	14	2.35%	22	2.87%	19	2.10%
Untreated Drinking Water at Risk of Containing Pathogens	276	43.81%	253	42.38%	260	33.94%	291	32.19%
Insufficient Treatment or Disinfectant Residual	31	4.92%	28	4.69%	74	9.66%	52	5.75%
Excessive Turbidity Compromising Treatment and Water Quality	29	4.60%	18	3.02%	26	3.39%	39	4.31%
Microbiological Sampling Data Unavailable/ Lack of Sampling Data	N/A	N/A	N/A	N/A	N/A	N/A	26	2.88%
Unacceptable Water Quality Results (Microbiological)	119	18.89%	127	21.27%	192	25.07%	259	28.65%
Surveillance Data Indicate Drinking Water Linked to Outbreak or Illness	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Inadequate Operations and Maintenance	31	4.92%	32	5.36%	34	4.44%	37	4.09%
Water Treatment Equipment Failure	15	2.38%	17	2.85%	26	3.39%	27	2.99%
Distribution System Integrity Failure	5	0.79%	6	1.01%	9	1.17%	14	1.55%
Inadequate Construction or Protection of Distribution, Storage, and Other Works	4	0.63%	6	1.01%	7	0.91%	2	0.22%
Routine Maintenance and Planned Works	12	1.90%	7	1.17%	9	1.17%	7	0.77%
Chemical and/or Physical Water Quality Parameters in Excess of Acceptable Concentrations	21	3.33%	34	5.70%	45	5.87%	60	6.64%

Note: Data do not include Vancouver Coastal Health's advisory reasons from 2018/19 to 2019/20 because its data system did not track that information. Additionally, some advisories may have more than one reason listed; therefore, when totaled, the sum of advisory reasons cannot be compared directly to the totals in Table 6.10 and Figure 6.8. The advisory reason "microbiological sampling data unavailable/lack of sampling data" was added for the 2021/22 fiscal year; therefore, there are no prior data for this category.

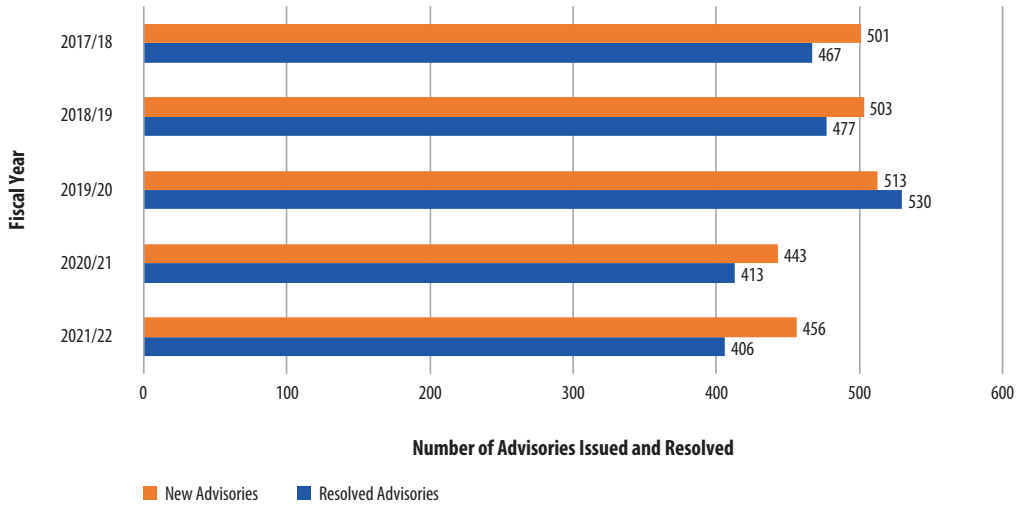
Source: Regional health authorities; 2018/19–2021/22.

reasons why advisories were issued. However, that year's results yielded questionable data, the accuracy of which could not be verified due to data system limitations; therefore, those data were omitted. In addition, multiple reasons were occasionally listed for advisories that were issued across health authorities. The PHO requested that health authorities count advisories only once based on the primary reason for the advisory, not the secondary reason(s). Secondary reasons often do not align with advisory counts and make tracking the overall reasons for issuing an advisory challenging. They are still useful, however, because they provide insight into problems encountered by water systems. The data in *Table 6.12* are presented as a preview of the ongoing efforts to improve how reasons for advisories are collected and recorded for future reports.

The number of new drinking water advisories issued compared to the number resolved is shown in *Figure 6.7*. Fiscal year 2019/2020 had the highest number of new and resolved advisories during the reporting period. In 2020/21, both new and resolved advisories decreased by 14 per cent and 22 per cent, respectively, compared to 2019/20. In 2021/22, the number of new advisories increased slightly and resolved advisories decreased marginally compared to the previous year. Except for the 2019/20 fiscal year, more new advisories were issued compared to advisories that were resolved. This indicates that not all new drinking water advisories were resolved in the year they were issued. Unfortunately, there are insufficient data to determine the reasons why the increase occurred.

Due to enhanced data collection at the regional health authorities, two new reporting metrics are available. *Figures 6.8* & *6.9* show the number of resolved and active drinking water advisories and their duration, respectively, for the 2018/19 to 2021/22 fiscal year.

Figure 6.7: Number of Drinking Water Advisories Issued and Resolved within Each Fiscal Year, BC, 2017/18 to 2021/22



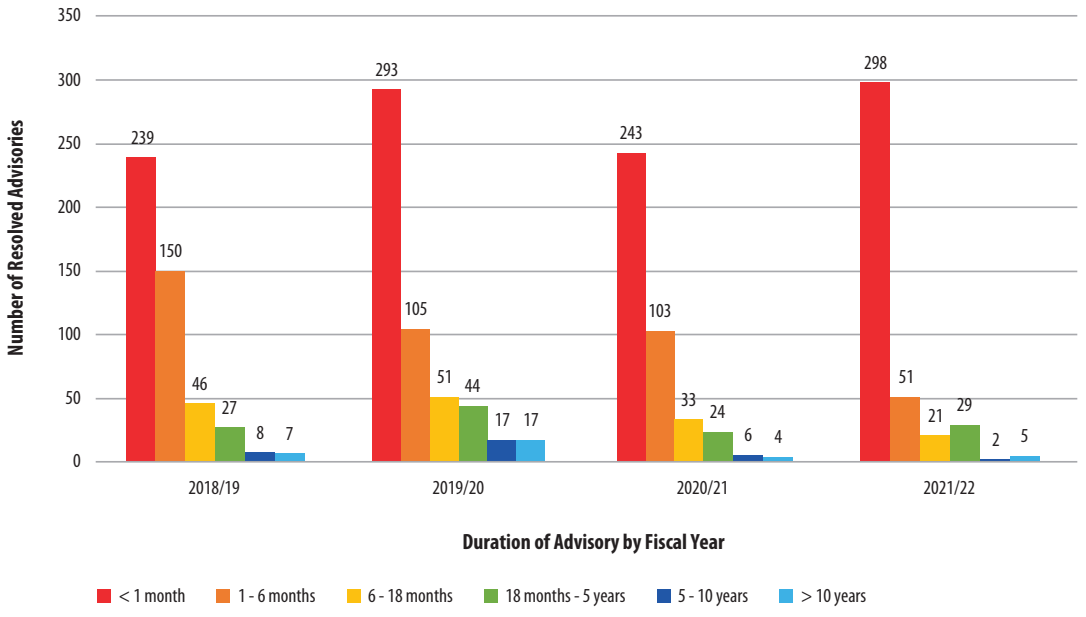
Source: Regional health authorities; 2017/18–2021/22.

Figure 6.8 shows that most drinking water advisories were resolved within 6 months of their issuance: more than 50 per cent were resolved within one month, and an additional 20 per cent were resolved within 1–6 months. This indicates that most of the advisories issued were resolved in a timely manner, before the reason for the advisory became systemic. Typically, low numbers of long-term advisories are resolved due to their complexity. For example, systems that have been issued a long-term drinking water advisory may have source water that is difficult to treat consistently, or they may lack the financial capacity to make required infrastructure upgrades to meet increasingly stringent water quality requirements.

Figure 6.9 shows the number and duration of active drinking water advisories. Overall, the addition of new advisories to the long-term categories (i.e., advisories that remain in place for more than 18 months) has been relatively stable since 2019. Unfortunately, most advisories are long-term advisories. On March 31, 2022, 561 advisories had been in place for more than 18 months, and 345 of them had been in place for five years or more. The large number of long-term advisories highlights the difficulty in removing long-term advisories from affected water systems. The data do not link the duration of an advisory to the type or size of the water system. Many long-term drinking water advisories have been issued to small water systems that do not have the capacity (financial or other) to rectify the issue(s) that have caused the advisory.

Advisories that lasted less than one month increased by 350 per cent from 2021 to 2022 (*Figure 6.9*). These advisories were issued predominantly in the Interior Health region, likely as a result of major wildfires and flooding that have affected the region.

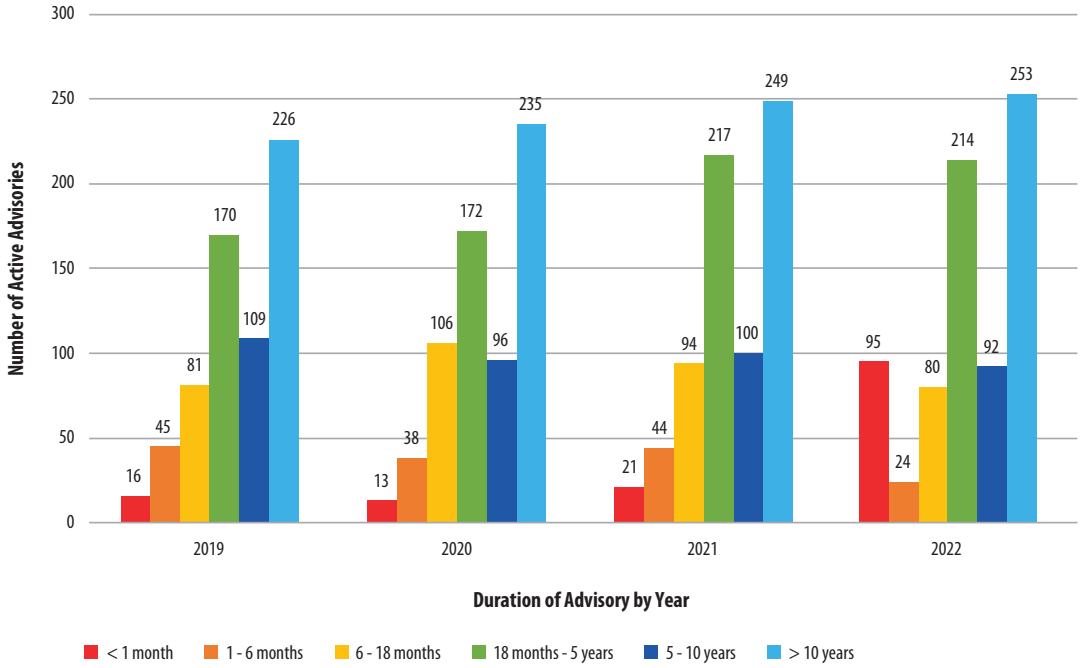
Figure 6.8: Number and Duration of Resolved Drinking Water Advisories by Fiscal Year, BC, 2018/19 to 2021/22



Note: There were insufficient data for fiscal year 2017/18; therefore, the data for that year were not included.

Source: Regional health authorities; 2017/18–2021/22.

Figure 6.9: Number and Duration of Active Drinking Water Advisories as of March 31, BC, 2019 to 2022



Note: Data were insufficient for 2018; therefore, they were not included. The combined total across all durations of advisories by year does not match the total number of advisories from *Table 6.11* due to current regional health authority data system limitations.

Source: Regional health authorities; 2017/18–2021/22.

A small water system in the West Kootenays of BC's interior. Diverted creek water passes through a screened collection system (left) to remove sticks, leaves, and debris before entering the storage reservoir (right). Water is delivered to homes on the system by gravity with no further treatment. The water system has been on a boil water notice for more than 30 years. Untreated drinking water is the most common cited reason for drinking water advisories in BC.

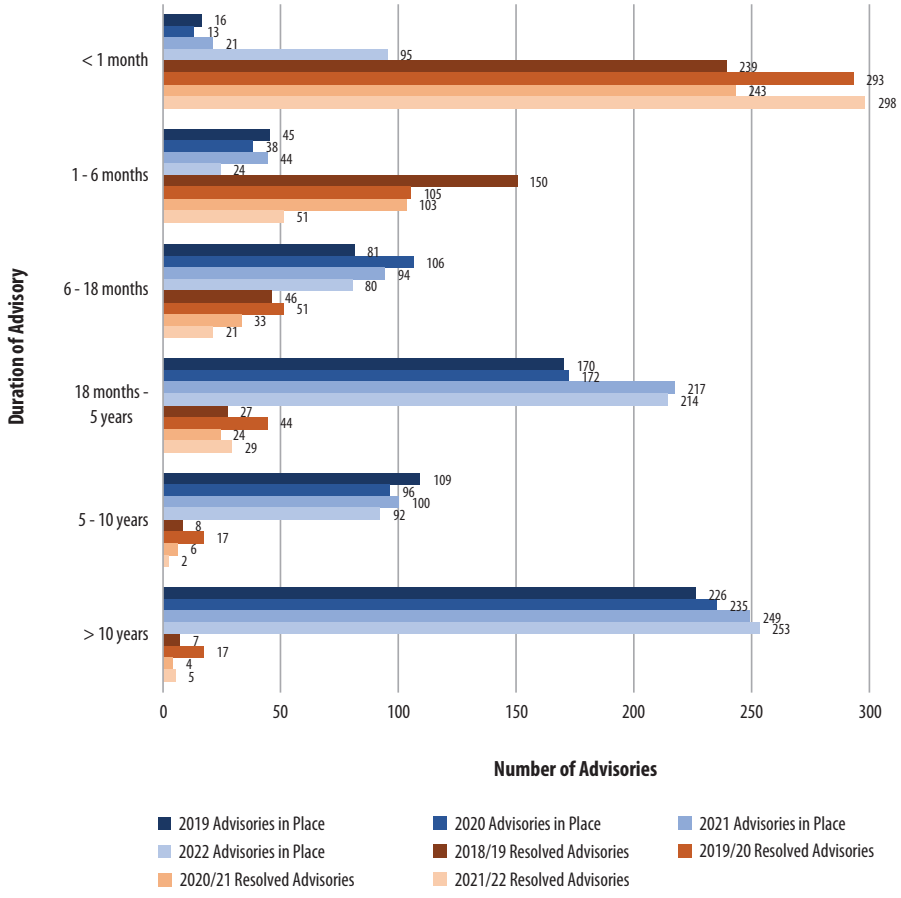
Photo credit: Greg Baytalan, Environmental Public Health, Interior Health.

Figure 6.10 shows the number and duration of resolved advisories for the entire fiscal year from 2018/19 to 2021/22, and the number and duration of active advisories on March 31 of those years. Most resolved advisories each year were short term in duration, whereas most advisories that remained in place were long term. Chapter 8, Section 8.3 describes the ongoing capacity building and support provided by HLTH and the regional health authorities to small water systems that tend to struggle with long-term advisories.

6.7.2. First Nations Drinking Water Advisories

First Nations Health Authority's Environmental Public Health Services (EPHS) provides recommendations to First Nations on when a drinking water advisory is warranted. It is the responsibility of Chief and Council to make decisions about implementing an advisory and to take the necessary measures to rectify the problems that led to the advisory. Some problems can be fixed with routine

Figure 6.10: Number and Duration of Drinking Water Advisories in Place as of March 31, 2019 to 2022, Compared to the Number and Duration of Resolved Drinking Water Advisories for the Entire Fiscal Year, BC, 2018/19 to 2021/22



Note: Drinking water advisories in place were as of March 31 for each year, whereas the number of resolved advisories were for the entire fiscal year. Fiscal year 2017/18 had insufficient data for reporting.

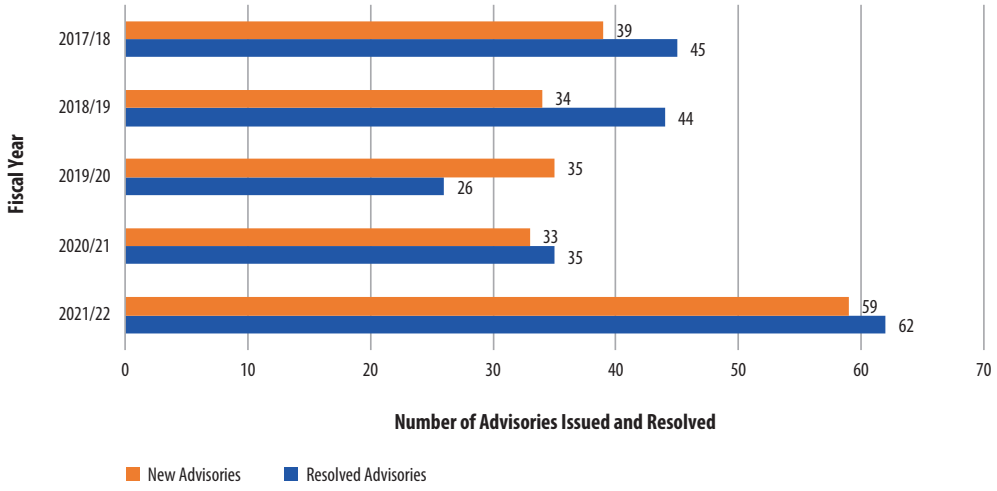
Source: Regional health authorities; 2018/19–2021/22.

maintenance. Other issues, such as infrastructure improvements, can require significant infrastructure investments by funding agencies such as Indigenous Services Canada (ISC). Once remedial measures have been completed, EPHS supports communities by verifying that the drinking water is safe and is protected from potential future problems.[28]

A drinking water advisory in a First Nations community can affect as little as a single-family dwelling (e.g., an individual water system)—it does not always represent a community-wide drinking water issue.[28] Drinking water advisories for community water systems and private water systems in First Nations communities in BC are posted and updated monthly on the FNHA website.[e] That information is current as of the date of posting. As of March 31, 2022, there were no long-term drinking water advisories on ISC-funded community water systems in BC.[f,28]

Figure 6.11 shows the number of First Nations drinking water advisories issued compared to the number resolved for 2017/18 to 2021/22. Apart from the 2019/20 fiscal year, more advisories were resolved than issued per fiscal year. Common reasons for the issuance of the advisories were due to microbiological exceedances, source contamination, and operations and maintenance.[28]

Figure 6.11: Number of First Nations Drinking Water Advisories Issued and Resolved within Each Fiscal Year, BC, 2017/18 to 2021/22



Source: First Nations Health Authority; 2017/18–2021/22.

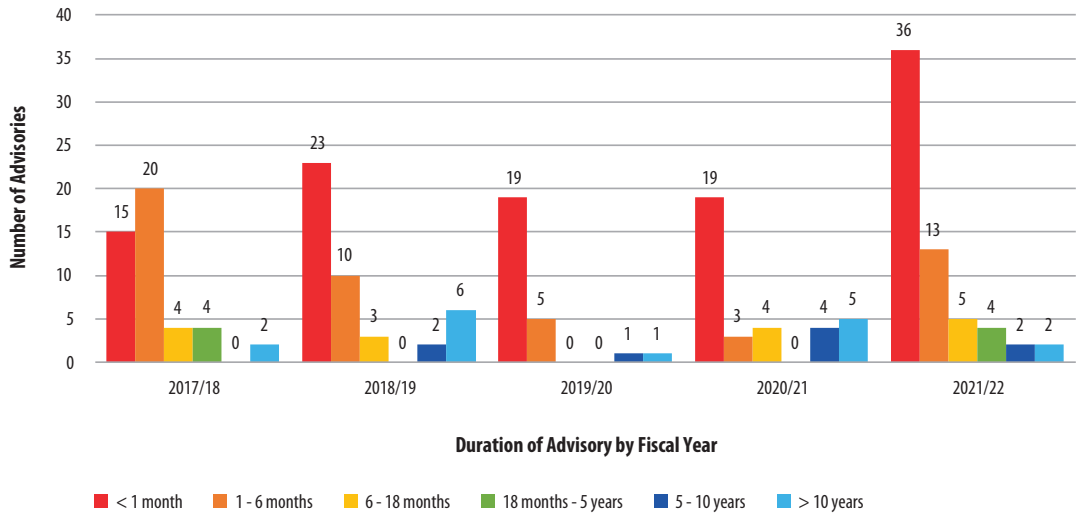
[e] *https://www.fnha.ca/what-we-do/environmental-health/drinking-water-advisories*

[f] The Government of Canada is committed to ending all long-term drinking water advisories in First Nations communities. It has budgeted approximately $2.76 billion over multi-year commitments and an additional $184.9 million per year going forward starting in 2020.

Figures 6.12 & *6.13* show the number of resolved and active drinking water advisories, respectively, by duration. As stated earlier, all long-term advisories on community water systems funded by ISC were resolved. The long-term advisories displayed in these figures were for systems that were not funded by ISC, which can include private systems, systems funded by a First Nation as an economic development, public systems, and micro systems that FNHA helps service.[36]

Of the advisories that have been resolved, most were in place for less than 6 months (*Figure 6.12*). Most of the active drinking water advisories that were in place as of March 31 from 2018 and 2022 had been in place for 18 months or longer (*Figure 6.13*). Small water systems on reserve that are not funded by ISC face many of the same water quality, infrastructure, and capacity challenges as other small and private water systems across BC in terms of resolving long-term advisories.

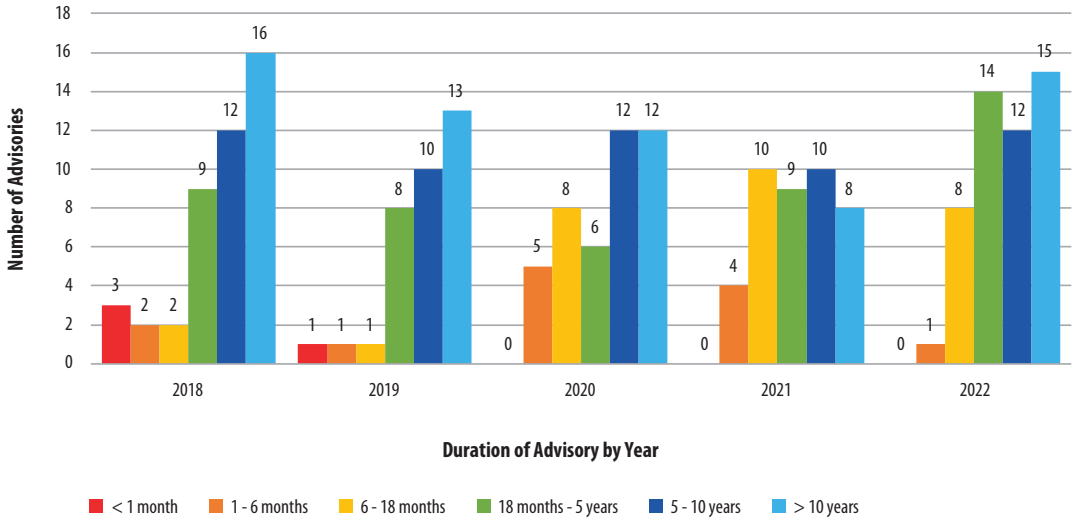
Figure 6.12: Number and Duration of First Nations Resolved Drinking Water Advisories, by Fiscal Year, BC, 2017/18 to 2021/22



Note: Long-term advisories are those covering private, economic development, public, and micro systems that are not funded by Indigenous Services Canada (ISC). They are funded either by the First Nation as an economic development or a private company or individual(s). All long-term advisories on community water systems that are owned and funded by ISC have all been resolved.[28]

Source: First Nations Health Authority; 2017/18–2021/22.

Figure 6.13: Number and Duration of First Nations Active Drinking Water Advisories in Place as of March 31, BC, 2018 to 2022



Note: Long-term advisories are those covering private, economic development, public, and micro systems that are not funded by Indigenous services Canada (ICS). They are funded either by the First Nation as an economic development or a private company or individual(s). All long-term advisories on community water systems that are owned and funded by ISC have all been resolved.[28]

Source: First Nations Health Authority; 2017/18–2021/22.

REFERENCES

[1] Government of Canada. Guidelines for Canadian drinking water quality – summary tables. [Internet]. Ottawa, ON: Government of Canada; 2020 Sep [cited 2022 Jun 02]. Available from: *https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html*.

[2] Government of Canada. Water quality – reports and publications. [Internet]. Ottawa, ON: Government of Canada; [modified 2023 May 30; cited 2023 Jun 02]. Available from: *https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality.html*.

[3] Health Canada. Canadian drinking water guidelines. [Internet]. Ottawa, ON: Health Canada; 2018 Aug 24 [cited 2022 Jun 02]. Available from: *http://hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/guide/index-eng.php*.

[4] Health Canada. Guidelines for Canadian drinking water quality: guideline technical document – manganese. [Internet]. Ottawa, ON: Health Canada; 2019 May 10 [cited 2022 May 30]. Available from: *https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-manganese.html*.

[5] BC Ministry of Health. Drinking water officers' guide. Guidance on manganese in drinking water. [Internet]. Victoria, BC: BC Ministry of Health; 2022 [cited 2022 May 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_b_-_13_manganese.pdf*.

[6] Martin. M. Personal communication. BC Ministry of Municipal Affairs; 2023 Nov 1.

[7] Village of Burns Lake. Public Works. [cited 2023 Nov 10]. Available from: *https://burnslake.ca/public-works/*.

[8] Health Canada. Guidelines for Canadian drinking water quality: guideline technical document – lead. [Internet]. Ottawa, ON: Health Canada; 2019 March 8 [cited 2022 Jun 07]. Available from: *https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-lead/guidance-document.html*.

[9] BC Ministry of Health. Drinking water officers' guide. Guidelines on evaluating and mitigating lead in drinking water supplies, schools, child care facilities and other buildings. [Internet]. Victoria, BC: BC Ministry of Health; 2019 [cited 2022 Aug 31]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_b_-_12_evaluating_and_mitigating_lead.pdf*.

[10] BC Office of the Provincial Health Officer. Clean, safe, and reliable drinking water: an update on drinking water protection in BC and the action plan for safe drinking water in British Columbia 2019. [Internet]. Victoria, BC: BC Office of the Provincial Health Officer; 2019 [cited 2022 Feb 17]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/pho-drinking-water-report-2019.pdf*.

[11] BC Ministry of Environment and Climate Change Strategy. Response to request for data in support of the PHO report [email from J Mack]; 2022 Feb 22.

[12] Drinking Water Protection Act [SBC 2001, c.9] [statute on the Internet]; [cited 2022 Feb 01]. Available from *https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/01009_01*.

[13] Vancouver Coastal Health Authority. Response to request for information regarding COVID-19 impacts to drinking water programs in British Columbia [email from P Muirhead]; 2021 Jul 7.

[14] Interior Health Authority. Response to request for information regarding COVID-19 impacts to drinking water programs in British Columbia [email from I Norlin]; 2021 Sep 07.

[15] Drinking Water Protection Regulation [B.C. Reg. 200/2003] [statute on the Internet]; [cited 2021 Dec 15]. Available from: *http://www.bclaws.ca/civix/document/id/complete/statreg/200_2003*.

[16] BC Ministry of Health. Drinking water officers' guide: Part A. Legislative requirements. [Internet]. Victoria, BC: BC Ministry of Health; 2022 [cited 2022 Apr 27]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_a_-_legislative_requirements.pdf*.

[17] Enhanced Water Quality Assurance. Response to request for updates to the status of drinking water in British Columbia [email from C Lee]; 2022 Aug 05.

[18] Provincial Health Services Authority. BC Centre for Disease Control Public Health Laboratory. Response to request for updates to the status of drinking water in British Columbia [email from C Tchao and C Lee]; 2021 Jul 16.

[19] Prystajecky N. Personal communication. Provincial Health Services Authority. BC Centre for Disease Control Public Health Laboratory; 2020 Oct 01.

[20] Enhanced Water Quality Assurance. EWQA virtual audit plan. [Internet]. Vancouver, BC: BC Centre for Disease Control Public Health Laboratory; 2020.

[21] Enhanced Water Quality Assurance. Enhanced water quality assurance brochure. [Internet]. Vancouver, BC: BC Centre for Disease Control; [cited 2022 June 22]. Available from: *http://lmlabs.phsa.ca/Documents/EWQA%20Brochure%202017%20v.1%20%282%29%20%282%29.pdf*.

[22] Tchao C. Personal communication. Provincial Health Services Authority. BC Centre for Disease Control Public Health Laboratory; 2021 Dec 01.

[23] Health Act Communicable Disease Regulation [B.C. Reg. 4/83] [statute on the Internet]; [cited 2022 Feb 01]. Available from *https://www.bclaws.gov.bc.ca/civix/document/id/loo84/loo84/12_4_83*.

[24] BC Centre for Disease Control Public Health Laboratory. Reportable diseases data dashboard [Internet]. Vancouver, BC: BC Centre for Disease Control Public Health Laboratory; [cited 2021 Jun 02]. Available from: *http://www.bccdc.ca/health-professionals/data-reports/reportable-diseases-data-dashboard*.

[25] HealthLinkBC. Giardia infection. [Internet]. HealthLinkBC File Number: 10; [updated 2022 Mar; cited 2022 May 30]. Available from: *https://www.healthlinkbc.ca/healthlinkbc-files/giardia-infection*.

[26] HealthLinkBC. Cryptosporidium infection. [Internet]. HealthLinkBC File Number: 48; [updated 2018 Feb; cited 2022 May 30]. Available from: *https://www.healthlinkbc.ca/healthlinkbc-files/cryptosporidium-infection*.

[27] Canadian Network for Public Health Intelligence. Outbreak summary reports. Extracted 2022.

[28] First Nations Health Authority. Response to request for updates to the status of drinking water in British Columbia [email from R Fleming]; 2022 Aug 28.

[29] HealthLinkBC. Disinfecting drinking water. [Internet]. HealthLinkBC File Number: 49b; [updated 2021 Jul; cited 2022 Mar 21]. Available from: *https://www.healthlinkbc.ca/healthlinkbc-files/disinfecting-drinking-water*.

[30] Hunter PR, MacDonald AM, Cater RC. Water supply and health. PLoS Med. 2010 Nov;7(11):e1000361; [cited 2022 Mar 21]. Available from: *https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1000361*.

[31] Government of British Columbia. Water quality notifications. [Internet]. Victoria, BC: Government of British Columbia; [cited 2022 Mar 21]. Available from: *https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/drinking-water-quality/notices-boil-water-advisories*.

[32] Northern Health Authority. NH Health Protection and Disease Prevention (HPDP) Program update, elevated manganese in drinking water - guidance process, June 2020 [email from S Wadden]; 2020 Jun 17.

[33] Government of British Columbia. Wildfire season summary [Internet]. Victoria, BC: Government of British Columbia; [cited 2022 Jun 07]. Available from: *https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary*.

[34] Associated Environmental Consultants Inc. Review of 2017 flood response: Okanagan Lake regulation system and Nicola Dam. [Internet]. Vernon, BC. Prepared for the BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development; 2017. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/integrated-flood-hazard-mgmt/2017_flood_response_report_final.pdf*.

[35] BC Ministry of Environment and Climate Change Strategy and GeoBC. Flood Water Quality Monitoring Task Force Hub. Available from: *https://fwqmtf-bcgov03.hub.arcgis.com/*.

[36] Fleming R. Personal communication. First Nations Health Authority; 2022 Feb 15.

CHAPTER

7

Abatement and Enforcement

Effective regulatory drinking water protection programs require both abatement and enforcement programs. Abatement involves working collaboratively with system owners and operators to prevent and/or correct drinking water quality concerns. Enforcement involves taking appropriate action when violations of specific requirements occur.[1] Drinking water programs in BC focus primarily on abatement activities, which include regular inspections, education, and engagement. While enforcement of the *Drinking Water Protection Act* (DWPA) occurs when necessary, drinking water programs across BC use a progressive enforcement framework that focuses on hazard abatement and gaining compliance through collaboration and education. This chapter presents an update on program resources, abatement and enforcement activities, and investigations and reviews for fiscal years 2017/18 through 2021/22.

7.1 Drinking Water Program Resources

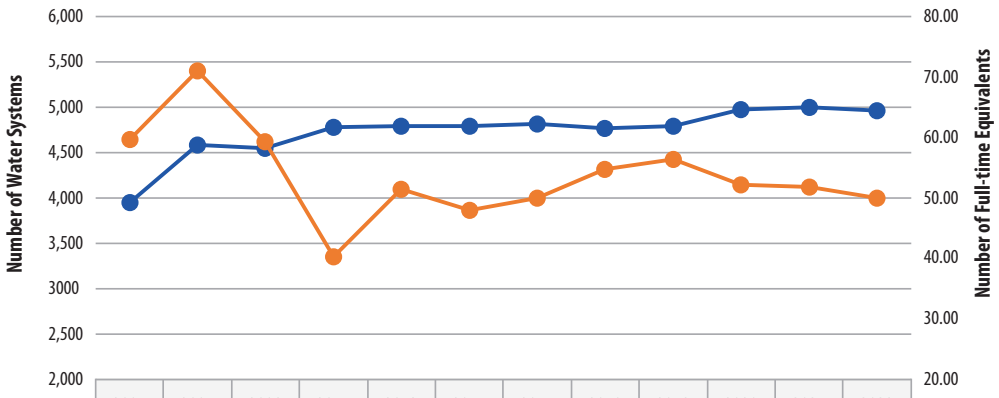
To carry out their mandate under the DWPA, the regional health authorities must have sufficient resources and staff to implement abatement and enforcement activities to protect the public. Within the regional health authorities, environmental health officers are delegated the authority of a drinking water officer (DWO), and they administer the DWPA and the Drinking Water Protection Regulation. Drinking water programs vary across the province: some regional health authorities have environmental health officer positions that are dedicated to drinking water, while others have environmental health officer positions that deal with all aspects of the environmental health program, including drinking water. The total number of DWO delegates and support staff varies in each regional health authority, and is based on a variety of factors, including the number of drinking water systems in the health authority and the organizational structure of the health authority.

A full-time equivalent (FTE) is a measure of the amount of time spent by all the people working on drinking water, based on how many people would have been involved if they worked full time on drinking water. It does not measure the total number of people who have a role in drinking water protection. For example, if a medical health officer spends one day per week working with drinking water issues, that would equal 0.2 FTE. If five environmental health officers each work one day per week on drinking water, that would equal 1.0 FTE.

From 2018 to 2022, the number of FTEs that supported work on drinking water within the health authorities drinking water programs decreased slightly (*Figure 7.1*). In 2022, there were 49.95 FTEs, excluding clerical and administrative support, which was 11 per cent lower than in 2019, when there were 56.40 FTEs. It is important to note that these numbers represent a fully staffed drinking water program; actual staffing levels due to vacancies may not be captured in the data.

The FTE numbers reported in *Figure 7.1* and *Table 7.1* represent fully funded positions, whether they were filled or not. Some regions had high vacancy rates, such as Northern Health, which experienced a 31 per cent staffing reduction in 2021 compared to 2020 due to difficulties in filling positions in remote locations.

Figure 7.1: Number of Full-time Equivalent Positions Working within Regional Health Authority Drinking Water Programs Compared to the Number of Permitted Water Systems, BC, as of March 31, 2005 to 2022



	2005	2007	2009	2011	2013	2015	2017	2018	2019	2020	2021	2022
Number of Water Systems	3,957	4,591	4,550	4,779	4,798	4,800	4,825	4,773	4,799	4,973	5,001	4,968
Number of Full Time Equivalents	59.80	71.10	59.40	40.30	51.50	48.00	50.00	54.75	56.40	52.25	51.80	49.95

Year

Note: Full-time equivalents (FTEs) for clerical support were not included in these data. Data points reflect the number of each as of March 31 of that calendar year. These numbers represent normalized staffing levels and do not always capture ongoing vacancies within the programs.

Source: Regional health authorities; 2017/18–2021/22.

Table 7.1: Number of Full-time Equivalent (FTE) Staff Appointed or Delegated the Duties of a Drinking Water Officer under the *Drinking Water Protection Act*, by Regional Health Authority and Position, BC, on March 31, 2022

Regional Health Authority	Medical Health Officers	Environmental Health Officers (EHOs)			Public Health Engineers in Support of Drinking Water Program	Managers in Support of Drinking Water Program	Total
		Drinking Water-focused/ Specialist	Generalist with Duties in Drinking Water	Supervisors of EHOs with Duties in Drinking Water			
Island Health	1.50	1.00	7.25	1.00	2.00	0.50	**13.25**
Northern Health	0.30	0.00	2.50	0.45	2.00	0.40	**5.65**
Vancouver Coastal Health	0.25	1.00	2.75	0.50	0.50	0.30	**5.30**
Interior Health	0.50	10.00	2.00	2.00	2.50	1.00	**18.00**
Fraser Health	0.15	5.60	0.00	0.00	1.00	1.00	**7.75**
Total	**2.70**	**17.60**	**14.50**	**3.95**	**8.00**	**3.20**	**49.95**

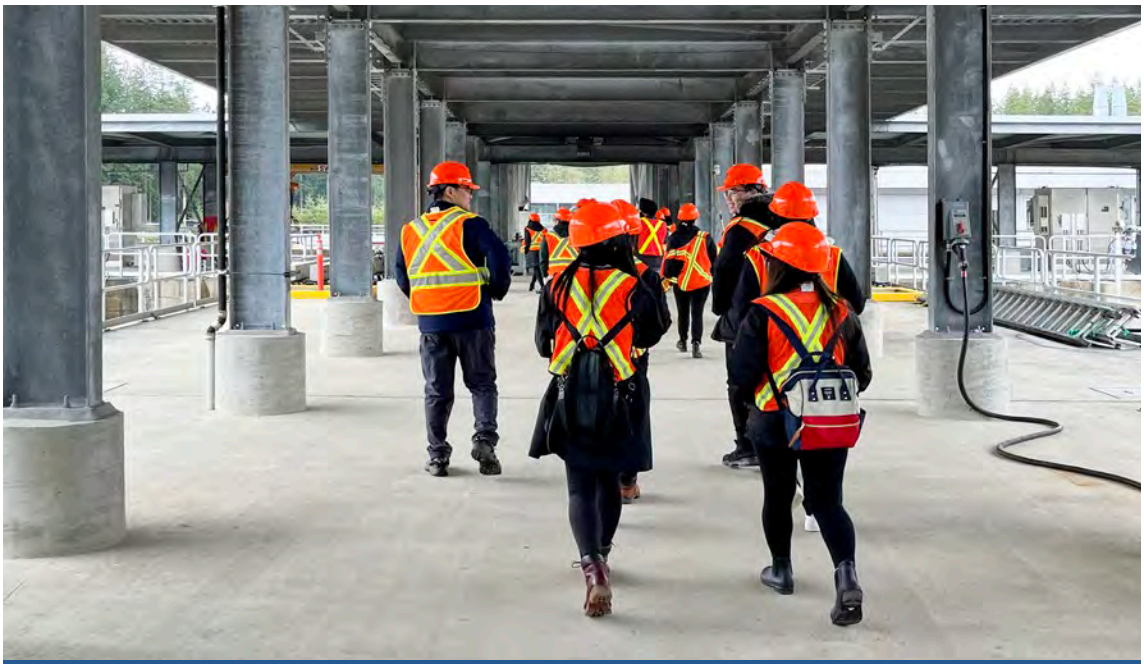
Note: The FTEs listed are the number of FTEs normally assigned to Health Authority drinking water programs, and do not reflect any temporary staffing reassignments or other competing responsibilities. The amount of time of an EHO's time spent on drinking water is difficult to capture with perfect accuracy; therefore, it is estimated by the regional health authorities.

Source: Regional health authorities; 2022.

This increased to 54 per cent in 2022 compared to 2020. With issues surrounding turnover and recruitment, positions often remain vacant for more than 90 days. The FTE numbers for the other health authorities (*Table 7.1*) do not account for the impacts of the COVID-19 pandemic. Those impacts were considerable—staff were reassigned to duties such as contact tracing to support the pandemic response (see Chapter 9 of this report). These redeployments resulted in reduced staffing levels that largely affected the overall drinking water program. While not all regional health authorities have been able to calculate how much time staff spent on the pandemic response, it has been reported that the reduction varied from 40 to 80 per cent, depending on the region.[2]

The number of permitted water systems in BC increased by 4 per cent from 4,773 on March 31, 2018 to 4,968 as of March 31, 2022 (*Figure 7.1*). Water system numbers can change due to system closures or amalgamations, and to the identification or creation of new systems. Based on the number of FTEs and water systems as of March 31, 2022, there were approximately 155 water systems per environmental health officer, and 621 water systems per public health engineer.

The ratios of regional health authority drinking water program staff to the increasing numbers of water supply systems were already identified as "troubling" in the 2019 Provincial Health Officer (PHO) drinking water report.[3] The impacts of the pandemic response exacerbated this situation during the 2020/21 fiscal year,[2] and regional health authorities were still recovering from those impacts in 2021/22. Therefore, DWOs and those delegated with the duties of a DWO had less time to conduct proactive water supplier education and support, facility inspections, and community engagement (see Chapter 9 of this report). As a result, regional health authorities have had to work strategically with limited resources to create focused approaches to responding to permitting approvals, complaints, emergencies, and other demand-driven work. Returning to normal staffing capacities and alleviating the backlog of pending compliance activities may require alternative strategies and initiatives on a regional and provincial level.



Students from the Environmental Public Health program at the British Columbia Institute of Technology (BCIT) touring Metro Vancouver's Seymour-Capilano Filtration Plant, which treats water from the Seymour and Capilano water reservoirs. BCIT is one of six post-secondary institutions in Canada, and the only one in BC, that offer accredited training for becoming an environmental health officer (also referred to as a public health inspector) by the Canadian Institute of Public Health Inspectors Board of Certification. To become an environmental health officer and receive a Certificate in Public Health Inspection (Canada), graduates from the program must fulfill all of the Board's requirements. For more information on becoming a certified environmental health officer, visit *https://ciphi.ca/certification/*.

Photo credit: British Columbia Institute of Technology, Environmental Public Health program.

One response to the challenges of resourcing the drinking water program is the creation of the Strengthening Public Health Initiative (SPHI), led by the Ministry of Health and the PHO. The SPHI will inform a renewed provincial vision, strategic direction, and priorities for population and public health in BC. The SPHI has engaged and worked collaboratively with a variety of partners, including other government ministries, regional health authorities, the First Nations Health Authority, the Provincial Health Services Authority, and Indigenous partners. The SPHI will result in the renewed *BC's Guiding Framework for Public Health*,[a] which will be supported by an action plan with population health baseline data and indicators, as well as system performance measures and population health measures. Together, these documents aim to provide clear and strategic direction to the population and the public health system, with the goal of promoting accountability and transparency.

7.2 Drinking Water System Inspections

DWOs have the authority to conduct inspections of water supply systems under section 40 of the DWPA,[4] which gives DWO delegates all the powers of a medical health officer under Division 1 of Part 4 of the *Public Health Act*. The BC *Drinking Water Officers' Guide* recommends that inspection frequency policies be developed based on risk and other relevant factors, such as the probability and impact of an adverse event occurring, numbers of users and demographics, system complexity, and past compliance history.[5]

Each regional health authority sets out policies for determining the frequency of inspections of drinking water supply systems (*Table 7.2*). All of the drinking water programs in the regions use a risk-based approach to prioritize inspections with water suppliers. Priority assessments determine for each supplier, the importance of compliance and oversight activities, and the risk of a threat to public health. This then determines the inspection frequency: high-risk water systems generally undergo more frequent inspections

Table 7.2: Drinking Water Inspection Frequency Targets, by Regional Health Authority

Island Health	**Based on a priority risk assessment:** • High priority – two inspections per year • Moderate priority – one inspection per year • Low priority – one inspection every other year
Northern Health	**Based on water supply system size:** • Large system – one inspection per year • Small system – one inspection every other year
Vancouver Coastal Health	**Based on a priority risk assessment:** • High priority – two inspections per year • Medium priority – one inspection per year • Low priority – one inspection every other year
Interior Health	**Based on a focused approach:** • Large systems – two inspections per year • Small systems – comprehensive inspections on a four-year cycle
Fraser Health	**Based on time period:** • One routine inspection per year for every water system

Source: Regional health authorities; 2021.

[a] More information is available at: *https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/health-priorities/bc-s-guiding-framework-for-public-health*

than do low-risk water systems. The frequencies noted in *Table 7.2* are for normal working conditions and staffing levels at the regional health authorities. As described by Interior Health, it will be difficult to achieve the stated targets based on current backlogs and staffing issues as a result of the pandemic response.[6]

Table 7.3 shows the percentage of water systems across the five regional health authorities that underwent an inspection or assessment from 2017/18 to 2021/22. As noted, the frequency of inspections is usually based on risk. Not every water system requires an annual inspection; therefore, the percentage of water systems that undergo an inspection each year is usually not 100 per cent. Inspection data are limited in scope because it is not possible to account for the extensive work drinking water officers do outside

Table 7.3: Percentage of Drinking Water Systems Inspected and Meeting Inspection Frequency Targets, by Regional Health Authority, BC, 2017/18 to 2021/22

Regional Health Authority	Fiscal Year	Percentage of Water Systems Receiving an Inspection or Assessment	Percentage of Water Systems Meeting Inspection Frequency Targets
Island Health	2017/18	56.0	70.4
	2018/19	36.0	75.9
	2019/20	57.3	85.4
	2020/21	8.1	20.0
	2021/22	12.0	–
Northern Health	2017/18	59.0	92.0
	2018/19	30.0	97.0
	2019/20	28.7	42.4
	2020/21	13.4	38.5
	2021/22	8.7	20.0
Vancouver Coastal Health	2017/18	51.5	–
	2018/19	49.1	–
	2019/20	37.2	–
	2020/21	22.9	–
	2021/22	35.1	–
Interior Health	2017/18	33.4	–
	2018/19	81.0	81.0
	2019/20	77.0	–
	2020/21	35.0	46.0
	2021/22	9.0	15.0
Fraser Health	2017/18	99.0	99.0
	2018/19	99.0	99.0
	2019/20	99.0	99.0
	2020/21	4.0	4.0
	2021/22	36.0	36.0

Note: Data on "Water Systems Meeting Inspection Frequency Targets" were not available from Island Health in 2021/22, Vancouver Coastal Health in 2017/18 to 2021/22, and Interior Health in 2019/20.

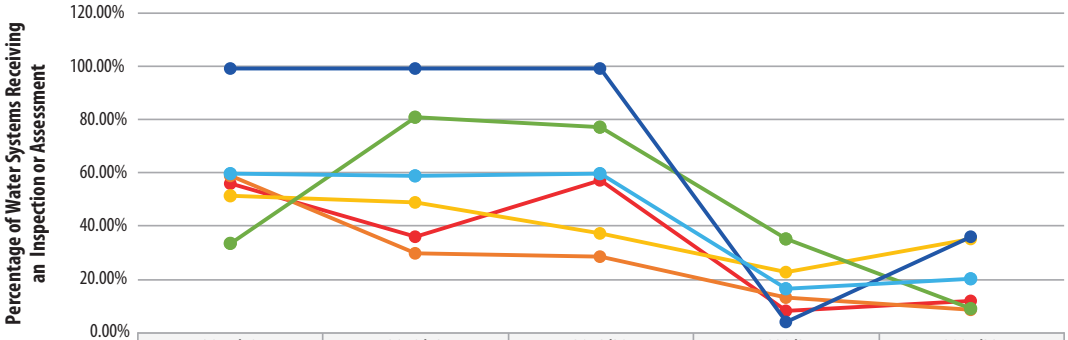
Source: Regional health authorities; 2017/18–2021/22.

of inspections to engage with water suppliers. This includes activities such as consultations, public meetings, presentations, investigations, and education.

Figure 7.2 shows the percentage of water systems that underwent an inspection or assessment within each regional health authority, as well as for the province overall. The number of water systems that underwent an inspection declined in all health authorities from 2019/20 through to 2020/21, and the decline continued in Northern Health and Interior Health through to 2021/22. During the 2021/22 fiscal year, only 20 per cent of permitted water systems across the province underwent an inspection. This is in contrast to a 60 per cent provincial inspection rate in 2019/20 (*Figure 7.2*). This can be correlated to the regional health authorities' COVID-19 pandemic response, during which inspections were limited, and travel to remote locations was either restricted or halted. This has created a backlog of water systems that require an inspection; therefore, considerable time and resources will be needed to meet the regional health authorities' targets. Due to the responses to the COVID-19 pandemic, problems that required action from DWOs may have gone undetected and may have led to water quality issues. Some of those issues may become apparent only when health protection departments return to full capacity and have resumed routine water program activities.

Chronic staffing shortages were reported in several of the regions, and staff redeployment only exacerbated the limited compliance activity that began in late 2019/20 and became fully apparent in 2020/21 and 2021/22. For example, 80 per cent of Fraser Health's drinking water program staff were redeployed to COVID-19 contact tracing, which left a limited complement of staff in place. As a result, routine inspections and responses to emergency situations and complaints were halted, but only during the 2020/21 fiscal year.[7]

Figure 7.2: Percentage of Water Systems Receiving an Inspection or Assessment, by Regional Health Authority and for the Province Overall, BC, 2017/18 to 2021/22



	2017/18	2018/19	2019/20	2020/21	2021/22
Island Health	56.0%	36.0%	57.3%	8.1%	12.0%
Northern Health	59.0%	30.0%	28.7%	13.4%	8.7%
Vancouver Coastal Health	51.5%	49.1%	37.2%	22.9%	35.1%
Interior Health	33.4%	81.0%	77.0%	35.0%	9.0%
Fraser Health	99.0%	99.0%	99.0%	4.0%	36.0%
Province	59.8%	59.0%	59.8%	16.7%	20.2%

Fiscal Year

Note: As indicated in *Table 7.3*, not all water systems underwent an annual inspection. However, data on "water systems meeting inspection frequency targets" were not available from all regional health authorities, so overall water system inspection numbers were used as an alternative. Because not all water systems require an annual inspection, it is not expected that 100 per cent of water systems would be inspected each year.

Source: Regional health authorities; 2017/18–2021/22.

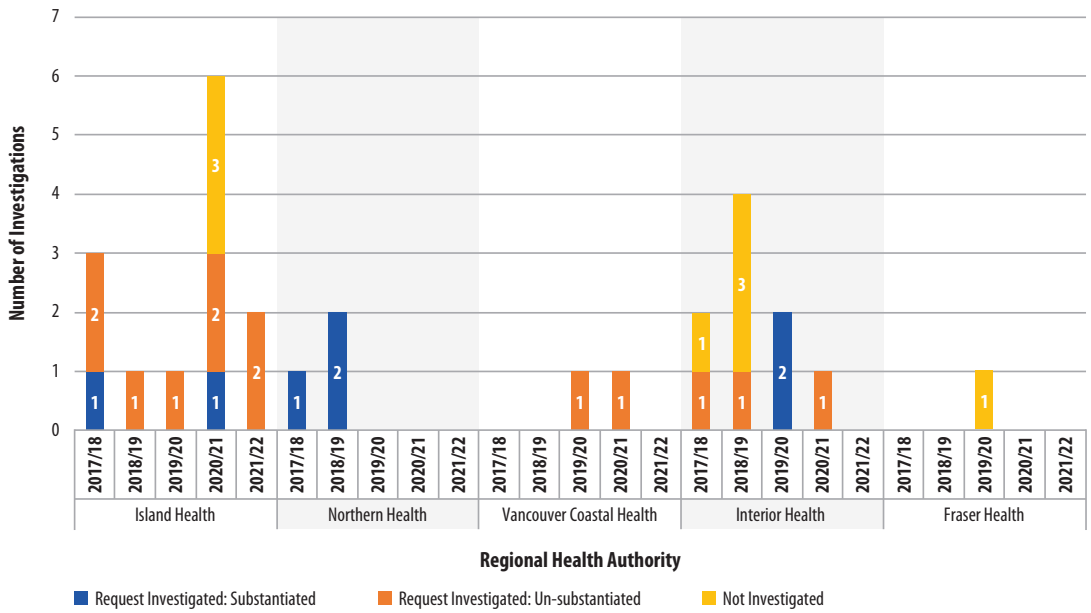
7.3 Investigation and Enforcement Activity

7.3.1 Section 29 Investigations

In addition to routine inspection and monitoring work, drinking water officials receive and respond to a variety of complaints and concerns about drinking water quality. Some complaints are received in the form of a request for an investigation under section 29 of the DWPA. Under section 29, any person has a right to request an investigation by a DWO if they think there is a threat to their drinking water source. The DWO is obliged to consider the request and must tell the person whether an investigation will be undertaken, and must report on the results of that investigation.[5] The *Drinking Water Officers' Guide* provides guidance to DWOs on responding to section 29 requests.[6]

Considerable regional health authority resources and time may be needed to conduct an investigation. As such, it is prudent that the number of requests received and investigated be recorded, regardless of whether or not a threat to drinking water was confirmed. *Figure 7.3* shows the number of section 29 investigations that were requested, by regional health authority, for fiscal years 2017/18 to 2021/22. Island Health and Interior Health received most of the requests; however, several of them did not warrant an investigation. Requests may not be investigated if there is a lack of evidence to proceed with the investigation or if the complaint refers to an issue on federal lands, which are outside the jurisdiction of the regional health authority. From April 1, 2017 to March 31, 2022, 20 section 29 requests were investigated; 35 per cent of them were substantiated. When investigations are required, often complex assessments, such as hydrogeological assessments, are needed, which require considerable time to investigate, are often beyond the skill set of a DWO, and place additional strain on available staffing resources. Section 29 investigations have been conducted in response to concerns such as the contamination of a drinking water source from a nearby sewage system, improperly stored chemicals or manure, or proposed mining or forestry operations.[8,9]

Figure 7.3: Number of Section 29 Investigations, by Regional Health Authority, BC, 2017/18 to 2021/22



Note: "Request Investigated: Substantiated" refers to a request sent to a health authority that had sufficient evidence to proceed with an investigation, and a threat to drinking water was confirmed. "Un-substantiated" requests were investigated, but evidence of a threat was lacking. Requests recorded as "Not Investigated" had insufficient evidence to begin an investigation or there was a lack of resources.

Source: Regional health authorities; 2017/18–2021/22.

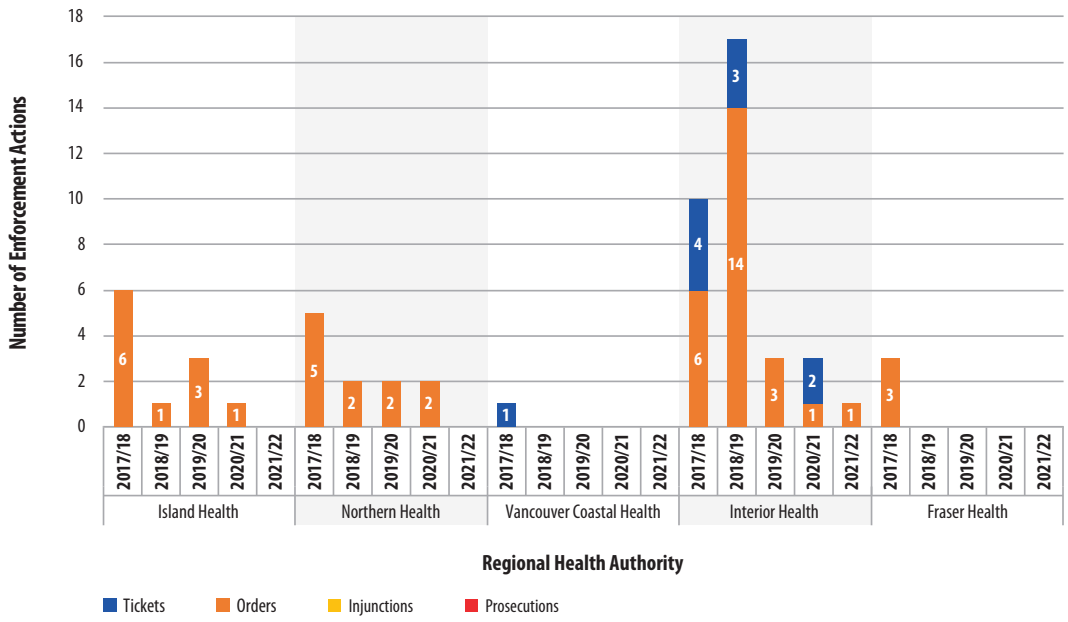
7.3.2 Enforcement Activities

The drinking water programs in BC follow a progressive enforcement approach (sometimes referred to as a graduated enforcement or a progressive compliance approach). Progressive enforcement entails the implementation of progressively escalating enforcement actions to eliminate, reduce, or mitigate risk, considering the risks to public health and the context and history of the situation. Several principles govern progressive enforcement, including using a collaborative and consultative approach when implementing actions, and ensuring transparency and consistency. Experts consider the progressive enforcement approach to be the best practice for achieving compliance with legislation and policy requirements.

DWOs have several enforcement tools available under the DWPA, such as issuing tickets, orders, injunctions, and prosecutions. *Figure 7.4* shows the number of enforcement actions taken by the regional health authorities from 2017/18 to 2021/22. The data indicate that across the regional health authorities, enforcement actions were limited to issuing tickets and orders. Of the 60 enforcement actions taken by regional health authorities, 17 per cent were tickets and 83 per cent were orders. Very few issues escalate to injunctions or prosecutions. This can be attributed to a number of reasons such as a resolution prior to escalation, or insufficient resources among health authorities to pursue progressive enforcement.

Most enforcement action was undertaken by Interior Health (57 per cent), followed by Northern Health and Island Health (18 per cent each) (*Figure 7.4*). Fraser Health and Vancouver Coastal Health each recorded 5 per cent or less of the total enforcement actions. The higher number of enforcement actions within Interior Health relative to the other regions could be directly correlated to the large number of small water systems within that health region, many of which require extra attention to ensure compliance with the DWPA and the regulations. Starting in 2019/20, Interior Health noted a decline in enforcement actions, which may have been related to staffing impacts due to the COVID-19 pandemic.

Figure 7.4: Number of Enforcement Actions, by Regional Health Authority, BC, 2017/18 to 2021/22



Note: There were no injunctions or prosecutions from 2017/18 to 2021/22.

Source: Regional health authorities; 2017/18–2020/21.

7.3.3 Reviews and Reconsiderations

Under section 39.1 of the DWPA, a person who is affected by a decision of a DWO that is made under specific sections of the Act can request a reconsideration or review of the decision.[5] The only decisions that can be reconsidered or reviewed under section 39.1 of the DWPA are those made under:

(a) section 19: drinking water officer authority in relation to assessments;

(b) section 25: hazard abatement and prevention orders;

(c) section 26: orders respecting contraventions;

(d) section 31 (4): request respecting plan initiation; or

(e) a decision resulting from a reconsideration under subsection (3)[b] of this section.[5]

Tracking of reconsiderations by regional health authorities has improved since the previous PHO drinking water report: only Interior Health has been unable to provide information on reconsiderations. Formal requests for reconsideration remain uncommon. Since 2017/18, only three reconsiderations were received (Island Health: 2017/18; Interior Health: 2021/22): two decisions were upheld, and one was varied.

Under section 39.1 of the DWPA, requests for reviews of a decision by the PHO are equally uncommon. From 2017/18 to 2021/22, the PHO received one request for a review. This is detailed in the box below, which provides an illustration of issues faced by small water systems.

7.4 Reports of Problems Related to Government Actions

Section 4.2 of the DWPA refers to a provision regarding accountability for provincial government action. It states that the PHO must report to the Minister[c] on any situation that, in the opinion of the PHO, significantly impedes the protection of public health in relation to drinking water and which arises in relation to the actions or inactions of government or government agencies.[5] "Impeding protection of public health" means a situation in which a policy or practice interferes with or threatens the ability of a water supplier to deliver potable water, or interferes with or threatens a drinking water officer's ability to prevent a drinking water health hazard.[5]

Nasookin Request for a Review of a Decision Summary

On January 10, 2022, a concerned group of water users from the Nasookin Improvement District near Nelson, BC asked the PHO to review a decision to issue a section 26 contravention order under the *Drinking Water Protection Act* that was made by a drinking water officer in Interior Health in 2021.[10] The request was to review the six required actions and the timelines the order required. The order gave the Nasookin Improvement District five years to install treatment to make the water potable. Given the long history of non-compliance of the water system, the concerned members felt this timeline was unreasonable. A boil water notice for untreated surface water has remained in place for the water system since 1992.

After inviting the board of trustees to make a submission for the review, the PHO paused the review after learning of the board's intention to request a reconsideration of the decision, citing new evidence.[11] After reviewing the new evidence, the drinking water officer determined that a reconsideration was not warranted because the new evidence was insufficient to change the original order. After receiving confirmation that the reconsideration had been completed, the PHO proceeded with the review. Upon reviewing the information on record, the PHO found the required actions and timelines outlined in the order were appropriate given the expected time required to develop plans, secure financial resources, and proceed through the construction permit application process.[12]

Although the PHO confirmed the decision, the Nasookin Improvement District is an example of the ongoing challenges many improvement districts face: chronic water quality issues, governance challenges, reliance on community volunteers as trustees, and inadequate financing to pay for needed upgrades to the system in order to provide potable water to users. Since the time of the review, the Nasookin Improvement District has failed to meet some of the early planning requirements of the order. In addition, the board of trustees resigned from their duties, which left the water system at risk of going into receivership (see Section 2.2.4 of this report).[13]

[b] Section 39.1 (3): If a reconsideration is requested and the drinking water officer is satisfied that there is sufficient new evidence respecting the matter to justify a reconsideration, the drinking water officer may reconsider the matter and may confirm, vary, or reverse the initial decision.

[c] Previously the Minister of Health, but as of October 2023, the Minister of Water, Land and Resource Stewardship.

As the senior public health official, the PHO holds the discretionary authority to assess what constitutes a significant impediment. That said, the following information provides guidance on the types of situations that may significantly impede the protection of public health in relation to drinking water and which may arise in relation to the actions or inaction of one or more ministries, government corporations, or other agents of the government. Such situations include but are not limited to:

- Government policies, guidelines, legislation, and/or statutory decisions that:
  - Hamper a DWO's ability to uphold the DWPA and take action to prevent a health hazard related to drinking water from occurring
  - Impede an investigation or assessment under the DWPA
  - Impede water supply system owners and/or operators from being able to meet legislative requirements under the DWPA
  - Conflict with the DWPA or its regulation
- Statutory decisions and/or authorizations under an enactment that in the opinion of a DWO create or may lead to the creation of a health hazard related to drinking water
- Failures of a government agency to:
  - Inform a DWO and/or water supplier of a situation or activities that create a health hazard related to drinking water or that have the potential to create a health hazard related to drinking water
  - Follow and/or enforce policies, guidelines, objectives, or legislation that protects drinking water[6]

As of March 31, 2022, the PHO had made no reports to the Minister that pertained to section 4.2 of the DWPA during the 2017/18 to 2021/22 reporting period. Because the PHO uses a progressive enforcement approach to resolving situations that negatively affect public health in relation to drinking water, there were no situations during this reporting period in which a section 4.2 report was required.

REFERENCES

[1] Canadian Council of Ministers of the Environment. From source to tap: guidance on the multiple-barrier approach to safe drinking water. [Internet]. Winnipeg MB: Federal-Provincial-Territorial Committee on Drinking Water and the CCME Water Quality Task Group; 2004 [cited 2022 Jun 14]. Available from: *https://ccme.ca/en/res/sourcetotap-finalenglish03-28-04.pdf*.

[2] Regional Health Authorities. Response to request for information on the effect of COVID-19 on drinking water programs; 2022 Mar 01.

[3] BC Office of the Provincial Health Officer. Clean, safe, and reliable drinking water: an update on drinking water protection in BC and the action plan for safe drinking water in British Columbia 2019. [Internet]. Victoria, BC: BC Office of the Provincial Health Officer; 2019 [cited 2021 Nov 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/pho-drinking-water-report-2019.pdf*.

[4] Drinking Water Protection Act [SBC 2001, c.9] [statute on the Internet]; [cited 2022 Feb 08]. Available from: *http://www.bclaws.ca/civix/document/id/complete/statreg/01009_01*.

[5] BC Ministry of Health. Drinking water officers' guide. [Internet]. Victoria, BC: BC Ministry of Health; 2022 [cited 2022 Apr 27]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_a_-_legislative_requirements.pdf*.

[6] Norlin J. Personal communication. Interior Health Authority; 2022 May 11.

[7] Choquette B. Personal communication. Fraser Health Authority; 2021 Jul 07.

[8] Beise R. Personal communication. Fraser Health Authority; 2021 Jul 26.

[9] Norlin J. Personal communication. Interior Health Authority; 2018 Aug 23 [cited 2022 May 11].

[10] Concerned Members of the Nasookin Improvement District. Request for review of a decision under the Drinking Water Protection Act; 2022 Jan 10.

[11] BC Office of the Provincial Health Officer. Request for a review of a decision and a request for reconsideration – Nasookin Improvement District. Victoria, BC; BC Office of the Provincial Health Officer; 2022 May 17.

[12] BC Office of the Provincial Health Officer. Request for a review of a decision of a drinking water officer – Nasookin Improvement District. Victoria, BC; BC Office of the Provincial Health Officer; 2022 Jul 21.

[13] BC Ministry of Municipal Affairs. Letter from Inspector of Municipalities to ratepayers of Nasookin Improvement District. Victoria, BC; BC Ministry of Municipal Affairs; 2022 Oct 26.

A 10,000 gallon steel reservoir with exterior insulation provides water storage for the Cedar Grove Estates water system located in Pemberton Meadows. The strata owned and operated water system provides treated groundwater (chlorination, ultraviolet radiation, and cartridge filtration) to 22 connections.

Photo credit: Dan Glover, Health Protection – Sea to Sky Region, Vancouver Coastal Health.

PART 4:

Small Water Systems in BC

Small water systems face a number of financial and management capacity issues. Part 4 (Chapter 8) reviews some of those challenges and provides an update on the flexible options for water treatment provided under the *Drinking Water Protection Act* and its regulation. The chapter also provides an overview of small water system exemptions, capacity building initiatives, and a summary of training and certification for small water system operators and bulk water haulers.

CHAPTER

8

Small Water Systems in BC

In BC, small water systems are defined as drinking water systems that serve 500 people or fewer in a 24-hour period. Small water systems in BC face many challenges in ensuring drinking water quality and complying with regulatory standards (operationally and financially). Despite efforts by drinking water officials, the provincial government, and local governments to provide flexible options for, and support to, small water systems, many of the regulatory compliance challenges and drinking water quality concerns remain. This chapter describes some of the activities key ministries and health authorities have undertaken to implement flexible options (e.g., exemptions to allow for non-potable water use or point-of-entry or point-of-use treatment) for small water systems. It also presents a review of small water systems classifications, operator training, and bulk water delivery in BC.

Farleigh Lake Water Users' Community (WUC), located in the South Okanagan. (Top left) Underground hatch of the insulated valve shack for the portion of the WUC distribution system fed by gravity. (Bottom) Farleigh Lake—the raw water storage reservoir for the WUC, which serves nine connections. The water is untreated, and a permanent boil water notice has remained in place for more than two decades. This WUC, like many other small water systems, faces financial and governance challenges that hinder drinking water quality improvements.

Photo credits: Greg Baytalan, Environmental Public Health, Interior Health.

8.1 Flexible Options for Small Water Systems

8.1.1 Non-Potable Water Systems

Section 3.1 of the Drinking Water Protection Regulation (DWPR) exempts non-potable water suppliers from section 6 of the *Drinking Water Protection Act* (DWPA), which states that a water supplier must supply water that is safe to drink and fit for domestic purposes without further treatment and that meets any requirements set out in the operating permit or regulations.[1,2] This exemption is predicated upon a system not providing water for human consumption or food preparation, or that is not connected to a water supply system that provides water for human consumption or food preparation purposes.[1]

Table 8.1 shows the number of non-potable water systems across the regional health authorities on March 31 of 2018 to 2020, and 2022. Data for 2021 were not requested from any of the regional health authorities because of resource limitations due to the COVID-19 pandemic. The total number of non-potable water systems increased slightly from 54 in 2017[3] to 55 in 2018 and 2019, and then to 75 in 2022. There was no total for 2020 because data from Northern Health were not available.

8.1.2 Point-of-Entry/Point-of-Use

Section 3.1 of the DWPR also exempts small water suppliers from the DWPA section 6 requirement to deliver potable water for domestic purposes if each recipient of the water from a small system has a point-of-entry or point-of-use treatment system that makes the water potable.[1,2] *Table 8.2* shows the number of point-of-entry/point-of-use treatment systems across the health authorities on

Table 8.1: Number of Approved Non-potable Water Systems, by Regional Health Authority, BC, as of March 31, 2018 to 2020, and 2022

Regional Health Authority	2018	2019	2020	2022
Island Health	18	18	24	24
Northern Health	13	13	–	21
Vancouver Coastal Health	2	3	3	6
Interior Health	3	4	4	7
Fraser Health	19	17	17	17
Total	**55**	**55**	**–**	**75**

Note: Approved non-potable water systems per section 3.1 of the Drinking Water Protection Regulation. Northern Health data were not requested for 2020. Data for 2021 were not requested from any of the health authorities because of resource limitations due to the COVID-19 pandemic response.

Source: Regional health authorities; 2017/18–2021/22.

Table 8.2: Number of Approved Point-of-Entry/Point-of-Use Treatment Systems for Small Community Water Systems, by Regional Health Authority, BC, as of March 31, 2018 to 2020, and 2022

Regional Health Authority	2018	2019	2020	2022
Island Health	10	3	3	2
Northern Health	2	2	–	2
Vancouver Coastal Health	12	7	7	6
Interior Health	4	4	1	3
Fraser Health	2	3	3	3
Total	**30**	**19**	**–**	**16**

Note: Northern Health data were not available for 2020. Data for 2021 were not requested from any of the health authorities because of resource limitation due to the COVID-19 pandemic response.

Source: Regional health authorities; 2017/18–2021/22.

March 31 of 2018 to 2020, and 2022. Data for 2021 were not requested from any of the regional health authorities because of resource limitations due to the COVID-19 pandemic. Most of these systems were located in Vancouver Coastal Health and Island Health in 2018 (40 and 33 per cent, respectively); however, those numbers declined in the following years. While the data do not suggest reasons for those declines, many of the problems highlighted in the 2019 Provincial Health Officer (PHO) drinking water report still exist.

Drinking water officials in the regional health authorities reported a lack of guidance on several key issues regarding point-of-entry/point-of-use treatment systems, which makes approval of those systems problematic. Issues identified include a lack of clarity regarding sampling requirements for decentralized treatment systems; difficulty in determining who should own the point-of-entry/point-of-use units (i.e., the water system or homeowners); challenges in establishing agreements with every homeowner to allow for access to, and maintenance of, these systems; and dysfunctional governance structures and limited powers for collecting fees and payments. While point-of-entry/point-of-use treatment may be a viable option for some small water systems, it is not a viable or cost-effective option for most, given source water quality limitations, the added costs of multiple treatment units, and the sampling and maintenance costs of decentralized treatment. Work is ongoing in the Ministry of Health and the regional health authorities to address these concerns.[3]

8.2 Small Water System Facility Classification and Operator Certification

In BC, the small water system classification under the Environmental Operators Certification Program (EOCP) includes water systems that serve a maximum population of 500 people and have a relatively simple treatment system. Training requirements for small water systems are determined by the drinking water officer. Under the DWPR, EOCP certification of operators of small water systems is not required unless it is included as a requirement on the operating permit for the system. Classification of small water systems is also not required under the DWPR.

Prior to March 31, 2021, the number of small water systems classified by the EOCP remained relatively stable (*Table 8.3*). During that same time period, the number of EOCP-certified small water system operators increased by 29 per cent.

The number of small water systems classified by the EOCP increased slightly from 2021 to 2022, but the numbers in both years were lower than those prior to 2021 (*Table 8.3*). The EOCP now considers many of these systems to be "expired" for a number of reasons, such as small water facility classifications have reached their expiration date and new classification forms have not been submitted, and systems have been decommissioned and/or amalgamated within regional districts, which makes renewals no longer necessary.[4] Also, as a result of the ongoing effects of the COVID-19 pandemic,

Table 8.3: Number of Small Water Systems Classified and Operators Certified by the Environmental Operators Certification Program (EOCP), BC, as of March 31, 2018 to 2022

	2018	2019	2020	2021	2022
Number of Small Water Systems Classified by the EOCP	873	901	911	855 (total) (557 expired)	865 (total) 500 (expired)
Number of EOCP-Certified Operators	627	756	808	1,184 (total) (493 not certified)	931 (total) 389 (not certified)

Note: Data include First Nations water systems and operators that have been classified as a small water system, and operators who have been certified as a small water system operator by the Environmental Operators Certification Program.

Source: Environmental Operators Certification Program; 2017/18–2021/22.

facility owners may not have been as actively involved in the day-to-day administration of the water system due to fear or concern of exposure to the virus, which could have led to lapses in classification, or certification renewals for small systems that had been classified by the EOCP.

The total number of EOCP-certified small water system operators increased by 47 per cent in 2021 compared to the previous year but then declined by 21 per cent in 2022 (*Table 8.3*). However, as with the small water system classification, many of the small water system operators no longer had an "active" certification status or were no longer "in good standing"; therefore, they were flagged internally at the EOCP as "not certified". The small water system operator certification status fluctuates for several reasons, as tracked by the EOCP Customer Relationship Manager (CRM) system.

It is important to note that for both system classifications and operator certifications, a large number of expired or not-certified counts does not necessarily mean that the systems are no longer operating or are functioning without operators. Currently, data on whether an operator was required to be certified as a condition on a permit to operate are not available (the DWPR does not require certification for small water system operators). As a result, determining non-compliance with a permit condition is not possible at this time. Similar to water systems (Level I-IV) described in Chapter 5, flagging a system as expired or an operator as not-certified is an internal tracking mechanism of the EOCP CRM system, and may indicate that the facility is operating without an appropriately certified operator. It is too early to determine how the "expired" or "not certified" results from 2021 and 2022 will continue to trend in the following years and will have to be monitored.

Although the number of classified small water systems and certified small water system operators is low, this does not mean that all small water systems have inadequately trained operators. The PHO has asked the regional health authorities to track whether small water systems have an operator who has appropriate knowledge and training for the system they operate, as an indicator of good operations for small water systems. Currently, three of the regional health authorities cannot report on this indicator because the data are not captured within their data systems. However, Island Health and Northern Health record information on small water system training, and were able to provide data for 2020 and 2021: 43 per cent of small water system operators within Island Health and 8 per cent within Northern Health had appropriate knowledge and training. The large difference in these numbers reflects the challenges in assessing this indicator. For 2022, the number of health authorities that were able to capture this information increased to three: Northern Health (76 per cent), Island Health (50 per cent), and Interior Health (18 per cent). It is not known if the remaining systems did not have an appropriate operator or simply had not been assessed. Additionally, the low results for this indicator within Interior Health is a reflection of the high proportion of small systems within that region and the existing challenges in tracking this information. Efforts are underway to collect and report these data in a more consistent manner in the future as part of the ongoing PHO indicator project (see Chapter 1 of the 2019 PHO drinking water report). Guidance provided to drinking water officers on the required training and competencies for small water system operators will assist in the collection of information for this indictor.

The previous PHO drinking water report made a recommendation, titled "Operator Training" (Recommendation 22), which stated the following:

> Develop a minimum recommended standard of training and competencies for a small water system operator and a bulk water hauler. Standards for small water systems should take into account the varying sizes, levels of complexity, water sources, and governance structures of these small systems.[3]

An update to this recommendation is provided in Chapter 11 of this report.

8.3 Capacity Building

Since the last PHO report, the following actions have been taken to support small water systems and small water system operators. In 2019, the Ministry of Health provided a contract to the BC Water and Waste Association to develop an online community network, the BC Small Water Systems Community Network, and a free course for small water system operators that describes the basics of system ownership and associated responsibilities.[5] Similarly, Interior Health's Drinking Water Systems Program continued to support the development and operation of the

A small water system serving six homes on the Lytton First Nation (top). The small system consists of two pumps, chlorine disinfection, a 10,000-gallon reservoir, and four hydrants (bottom left). A certified operator from the Lytton First Nation completing repairs to a small water system just days after the Lytton Creek wildfire (bottom right). Small water systems serving First Nations communities face many of the same challenges as other small water systems in BC.

Photo credit: Warren Brown, CWP CWWP, Operations & Maintenance Manager, Lytton First Nation.

British Columbia Small Water Systems Online Help Centre. This project was developed in partnership with Thompson Rivers University, Indigenous Services Canada, the EOCP, local governments, and industry consultants.[6]

Across all regional health authorities, improving education and outreach for operators of small water systems is supported. Various policies and guidelines have been established to help with operator training and voluntary certification. Environmental health officers also regularly review the level of complexity of small water systems, and advise of any additional training requirements. Additionally, the WaterSafeBC program has been promoted in some health authorities as an option for meeting training requirements.[7,8] Unfortunately, due to the COVID-19 pandemic response measures, most proactive work by regional health authority staff to build capacity and offer in-person training for small water systems was significantly impacted by staffing limitations caused by environmental health officer redeployments and restrictions to in-person gatherings (see Chapter 9 of this report).

8.4 Bulk Water Delivery

8.4.1 Bulk Water Haulers in BC

Under the DWPA, trucks used for bulk water delivery are included in the definition of a domestic water system.[2] Therefore, tank trucks or vehicle water tanks that are used for the delivery of potable water for domestic use in BC must have an operating permit. As a result, a bulk water delivery company may have several permits to operate because each water truck requires its own non-transferable permit. Bulk water haulers who have a permit to operate must fill their tanks only from a fill station (i.e., a source water supply) that has been approved by the drinking water officer. Most bulk water haulers fill their trucks from fill stations that are connected to an approved community water supply system. In rare situations where a community supply system is not available, a company or a local community may develop a stand-alone fill station on its own private water supply. If these fill stations provide potable water for domestic use, they must be permitted as any other domestic water system.

(Above) Northern Health inspecting a bulk water hauler operating out of Charlie Lake (Peace River Regional District). (Left) Lockable access hatch to the potable water tank for monitoring and filling the tank. (Right) Hoses labelled to indicate they are to be used only with potable water. Nozzles are also attached to a connection point to prevent contamination.

Photo credit: Eugene and Nadine Lucas, Lucas water Residential Services.

Data on bulk water fill stations from regional health authorities have improved compared to those reported in the 2019 PHO drinking water report. At that time, the regional health authorities were generally unable to report on the number of bulk water hauler fill stations that had their own private water source. *Table 8.4* shows the number of bulk water haulers and private bulk water delivery fill stations, by regional health authority, on March 31 of 2018 to 2020, and 2022. Northern Health had the most permitted water hauler vehicles in those years, and the most permitted fill stations in 2020 and 2022. Overall, across all regional health authorities, the number of permitted water hauler vehicles and fill stations were mostly constant, although there were minor fluctuations in some areas.

The previous PHO drinking water report made a recommendation, "Bulk Water Haulers" (Recommendation 20), which stated the following:

> Develop provincial guidelines for bulk water haulers to reflect current regulatory requirements and best practices.[3]

An update to this recommendation is provided in Chapter 11 of this report.

8.4.2 Bulk Water Operator Training and Certification

There are no specific training or certification requirements in the legislation, the *Drinking Water Officers' Guide*, or the regional health authority guidelines for bulk water haulers that pertain to operators of bulk water hauling vehicles.

Although not required, bulk water haulers can be certified through the EOCP as a bulk water operator; however, very few operators in BC hold this certification. According to the EOCP, 69 operators currently have or have had Bulk Water Delivery Operator Certification; however, most of them are in the Yukon (the EOCP certifies operators across BC and the Yukon). There are seven bulk water delivery operators in BC, six of which are certified. Of the 69 operators across BC and the Yukon, 24 have been flagged as "not certified" for the same reasons as small water system operators.[9]

As listed in Section 8.2, the previous PHO drinking water report made the recommendation, "Operator Training" (Recommendation 22), which included developing a minimum standard of training for bulk water haulers. An update to this recommendation is provided in Chapter 11 of this report.

Table 8.4: Number of Bulk Water Haulers and Private Bulk Water Delivery Fill Stations, by Regional Health Authority, BC, as of March 31, 2018 to 2020, and 2022

Regional Health Authority	2018		2019		2020		2022	
	Permitted Trucks	Permitted Fill Stations with Stand-alone Water Source	Permitted Trucks	Permitted Fill Stations with Stand-alone Water Source	Permitted Trucks	Permitted Fill Stations with Stand-alone Water Source	Permitted Trucks	Permitted Fill Stations with Stand-alone Water Source
Island Health	16	4	21	5	16	5	16	5
Northern Health	100	–	113	–	140	7	151	7
Vancouver Coastal Health	5	0	5	0	6	0	5	0
Interior Health	20	–	19	–	19	–	25	–
Fraser Health	9	–	9	0	9	0	8	0
Total	**150**	**–**	**167**	**–**	**190**	**–**	**205**	**–**

Note: At present, not all of the regional health authorities track information in their data systems on permitted fill stations with a private stand-alone water source. Data from all health authorities were not requested for 2021 because resources were limited due to the COVID-19 pandemic response.

Source: Regional health authorities; 2017/18–2021/22.

REFERENCES

[1] Drinking Water Protection Regulation [B.C. Reg. 200/2003] [statute on the Internet]; [cited 2022 Apr 25]. Available from: *http://www.bclaws.ca/civix/document/id/complete/statreg/200_2003*.

[2] Drinking Water Protection Act [SBC 2001, c.9] [statute on the Internet]; [cited 2022 Apr 25]. Available from: *http://www.bclaws.ca/civix/document/id/complete/statreg/01009_01*.

[3] BC Office of the Provincial Health Officer. Clean, safe, and reliable drinking water: an update on drinking water protection in BC and the action plan for safe drinking water in British Columbia 2019. [Internet]. Victoria, BC: BC Office of the Provincial Health Officer; 2019 [cited 2021 Nov 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/pho-drinking-water-report-2019.pdf*.

[4] Environmental Operators Certification Program. EOCP data submission in response to request for updates to the status of drinking water in British Columbia 2017/18 to 2020/21 [email from K Solanki]; 2021 May 18.

[5] BC Ministry of Health. Response to request for data in support of the PHO report [email from M Om Prakash]; 2022 Apr 12.

[6] Interior Health Authority. Response to request for updates to the status of drinking water in British Columbia 2021 [email from JI Norlin]; 2021 Sep 07.

[7] Interior Health Authority. Response to request for data in support of the PHO report [email from S Pollock]; 2022 Apr 21.

[8] Island Health Authority. Response to request for data in support of the PHO report [email from C Diplock]; 2022 Apr 20.

[9] Environmental Operators Certification Program. EOCP data submission in response to request for updates to the status of drinking water in British Columbia 2021/22 [email from K Solanki]; 2022 Jun 28.

Flooding in Sumas Prairie, Abbotsford during the 2021 atmospheric river.
Photo credit: City of Abbotsford.

PART 5:

Public Health and Climate-related Emergencies – Impacts on Drinking Water

From 2017 to 2022, BC experienced a global pandemic, catastrophic floods, and other climate-related events such as droughts, wildfires, and extreme temperatures. Part 5 examines the impacts of the COVID-19 pandemic (Chapter 9) and climate change and climate-related emergencies (Chapter 10) on water suppliers, regional health authority drinking water programs, and other partner agencies.

CHAPTER

9

The COVID-19 Pandemic and Drinking Water Programs in BC

In March 2020, in response to increasing numbers of cases, hospitalizations, and deaths associated with a novel coronavirus (SARS-CoV-2) and consequent infection (COVID-19), the World Health Organization declared a global pandemic. In BC, the Provincial Health Officer (PHO) responded by declaring a public health emergency under the *Public Health Act*, and issuing a series of orders and guidelines to help minimize the spread of COVID-19 and protect public health.[1] The provincial government in turn declared a provincial state of emergency to support public health and public safety response efforts. These measures were necessary to reduce COVID-19 infections, hospitalizations, and deaths; however, they also had many additional consequences,[a] including impacts on regional health authority drinking water programs and water suppliers in BC.

Importantly, the PHO affirmed that providing clean, safe drinking water to the public is an essential service[b] directly tied to health outcomes for the population of BC, which meant that water system operations and laboratory testing of drinking water quality were required to continue throughout the pandemic.[2,3] The PHO also advised that COVID-19-related workplace precautions (e.g., physical distancing, increased cleaning and disinfection practices, and hand hygiene) applied to water systems and water testing laboratories, and outlined temporary measures to address potential staff shortages and ensure continuity of operations for water systems during the pandemic. These temporary measures provided greater flexibility for staffing drinking water systems in terms of staff employment and redeployment, scheduling, training, and certification requirements.[4]

This chapter provides an overview of the challenges and impacts to the provincial drinking water program due to the COVID-19 pandemic, in areas such as staffing, water sampling, and water system inspections. This chapter also discusses how these challenges and impacts are being addressed by the regional health authorities and other partner agencies, along with the steps that can be taken to minimize the risk to BC's drinking water supply in future public health emergencies. The information in this chapter is based principally on reports and communications from the five regional health authorities, the First Nations Health Authority (FNHA), and the BC Centre for Disease Control's Public Health Laboratory (BCCDC PHL).

9.1 Overall Impacts on Drinking Water Programs in BC

The COVID-19 pandemic affected the capacity of regional health authorities and other partners to maintain and manage drinking water systems in BC, including impacts to routine water quality monitoring, drinking water system inspections, water treatment, outreach and education activities, drinking water system permitting, and resolution of drinking water advisories. In the

[a] For more information on the societal consequences of the COVID-19 response in BC, please visit: www.bccdc.ca/health-professionals/data-reports/societal-consequences-covid-19.

[b] In consultation with the PHO, the Province defined essential services as daily services that are essential to preserving life, health, public safety, and basic societal functioning in BC. They included operations and employees needed to operate and maintain drinking water and wastewater/drainage infrastructure and services that facilitate the transportation of essential supplies, such as essential services flights.

regional health authorities, large numbers of staff, including drinking program staff (i.e., environmental health officers [EHOs] delegated the duties of a drinking water officer [DWO]), were redeployed to undertake COVID-19-related activities such as contact tracing and enforcing orders of the PHO. These staff redeployments, combined with higher-than-usual staff vacancy rates, have resulted in a backlog of drinking water protection work.

Drinking water programs in BC have also been disrupted by COVID-19-related restrictions that inadvertently limited access to water sampling sites and to the couriers and laboratories that ship and analyze water samples. Because water system inspections and other routine work were paused or reduced to deal with the COVID-19 pandemic, problems that required action from EHOs may have gone undetected and may have led to water quality issues. Some of these issues may come to light only when health protection departments are back at full capacity and have resumed routine drinking water program activities. Without the capacity to maintain regular contact with water suppliers, EHOs and other officials may not have been informed of disruptions in operator duties such as maintenance and recordkeeping. Reduced overlap of shifts for drinking water system employees (e.g., due to staff illness or physical distancing requirements) may also have limited the transfer of information from water suppliers to the EHOs.[5]

While many of these challenges have been felt across BC, some have disproportionately affected smaller drinking water systems in rural and remote regions of the province. The COVID-19 pandemic has exacerbated the pre-existing challenges faced by regional health authority drinking water programs and drinking water systems in BC, particularly those faced by small water systems, as outlined throughout this report and in the 2019 PHO drinking water report. Additionally, water systems in areas that have also been affected by extreme temperatures, wildfires, flooding, or landslides have been particularly hard hit. The longer term effects of these events on drinking water programs in BC are unknown. The challenges that regional health authority drinking water programs and other interested parties faced during the pandemic, and the mitigation strategies they used to cope with them, are explored in more detail in the following sections.

9.1.1 Regional Health Authority Staffing Shortages and Service Pressures

Following the declaration of the COVID-19 pandemic in March 2020, all regional health authorities experienced staffing shortages due to the redeployment of drinking water program EHOs to contact tracing and other duties linked to COVID-19 response efforts.[6] In addition, extremely high numbers of staff vacancies were reported in some areas due to an insufficient supply of trained EHOs, staff relocating to other parts of the province to be closer to family during the pandemic, and staff relocating to other positions within the health authority or to positions in another regional health authority.[7] For example, as of March 31, 2021, a year into the pandemic, Northern Health had 24 EHO staff positions (full-time equivalents [FTEs]) available, but only 15 FTE positions were filled.[7]

These staff shortages resulted in substantial reductions in drinking water system inspections, assessments, and engagement activities across all regional health authorities from 2019/20 to 2020/21,[c] as demonstrated in *Table 7.3* and *Figure 7.2* (Chapter 7).[6] *Table 6.11* (Chapter 6) shows that the total number of drinking water advisories (boil water notices, water quality advisories, and do not use notices) increased in Fraser Health, Interior Health, and Northern Health from March 31, 2020 to March 31, 2021.[6] While there is a clear link between reduced staffing levels and the decline in inspections, assessments, and engagement activities with water suppliers, the degree to which drinking water advisory increases are linked to COVID-19 cannot be stated with certainty because environmental factors such as wildfires, flooding, and landslides have also played a role.

Interior Health's drinking water program operated with staffing levels ranging from 50 to 65 per cent throughout the first year of the pandemic (to March 31, 2021).[8] This was initially due to EHOs being reassigned to other duties during the early phases of the pandemic. In response, the drinking water systems program team focused resources to ensure critical emergency and complaint responses and investigation

[c] Data on the percentages of Vancouver Coastal Health water systems that met inspection frequency and engagement targets are not available.

Provincial Health Officer Dr. Bonnie Henry providing an update on COVID-19 on May 4, 2020, with Health Minister Adrian Dix.

Photo credit: Province of British Columbia.

services were maintained in 2020/21. As the health authority's response rolled out, additional resources and positions allowed reassigned EHOs to return to their original roles. However, by that time, the broader provincial and national COVID-19 response had created a systemic shortage of qualified EHOs.[8] Many EHOs in Interior Health left smaller rural areas for larger urban centres, which led to significant staff shortages in regions and communities such as the Kootenays, Salmon Arm, and Williams Lake.[9] Numerous drinking water program vacancies due to staff relocation, retirement, and medical leaves remain unfilled and resulted in a considerable number of overdue inspections.[8] Interior Health estimates it will take at least two years to complete these overdue inspections and reverse any non-compliance trends that have occurred as a result of the pandemic and climate-related disasters.[9]

In Fraser Health, five out of six drinking water program EHOs (more than 80 per cent) were redeployed to the Fraser Health COVID-19 Contact Tracing Centre for approximately 14 months.[10] The drinking water program manger and remaining EHO were able to respond only to emergencies and complaints. While Fraser Health typically completes close to 100 per cent of its routine inspections each year, it was able to complete only 4 per cent between April 1, 2020 and March 31, 2021 (*Table 7.3* [Chapter 7]).[10]

As in other regional health authorities, many of Vancouver Coastal Health's EHOs were reassigned to contact tracing duties as part of the pandemic response.[11] Beginning in April 2020, Vancouver Coastal Health discontinued in-person routine inspections throughout its entire drinking water program but continued to respond to demand work (i.e., reviewing permit applications, dealing with complaints, and responding to emergencies). Vancouver Coastal Health reported that as of March 31, 2021, it had addressed all drinking water system emergencies during the pandemic but had not resumed routine water system inspections.[11] In addition to delayed inspections, EHOs had a backlog of work to complete in other program areas.[11]

In Island Health, the effects of drinking water program staff redeployments due to COVID-19 were felt in all areas of the health authority.[12] For example, *Table 7.3* (Chapter 7) shows that the percentage of drinking water system inspections completed by EHOs in 2020/21 decreased from 57.3 per cent in 2019/20 to 8.1 per cent in 2020/21. Island Health also noted that a lack of regular communication between DWOs and water suppliers may have impacted program targets and objectives.[12] While Island Health reported no known impacts to water suppliers, it identified the need for water suppliers to ensure sufficient staff coverage and ensure supply chains were in place to maintain water system operation and potable water supply.[12]

Northern Health reported a decline in staffing levels from 91 per cent on March 31, 2020 to 62.5 per cent on March 31, 2021.[7] Filling vacant positions was challenging, especially in more remote areas; many qualified candidates in Northern Health left to fill positions in less remote areas of the province. In addition, the remaining EHOs in Northern Health were required to focus on COVID-19-related work at the expense of routine inspections.[7]

All regional health authority drinking water programs experienced staff redeployments and/or staffing shortages during the pandemic. As a result, fewer routine drinking water system inspections were performed by EHOs, which resulted in a backlog of work that remains to be completed (including making changes to regional health authority databases to implement the PHO indicators). In addition to regional health authority drinking water programs, the COVID-19 pandemic affected drinking water suppliers.

9.1.2 Impacts on Water Supply Operators and Persons in Charge of Drinking Water Systems

In May 2020, at the request of the Provincial Drinking Water Officer, the EOCP surveyed chief operators and persons in charge of drinking water systems to assess the impacts of COVID-19 on their work. The survey was sent to 661 respondents, of which 10 per cent replied. Approximately 45 per cent of the respondents either agreed or strongly agreed with the statement "COVID-19 has had a significant impact on my facility's operations."[13] Slightly fewer than 25 per cent of the respondents disagreed or strongly disagreed with the statement; the remainder of respondents were neutral.[13]

Approximately 85 per cent of the respondents reported implementing workplace safety plans in response to the pandemic, and close to 80 per cent of them indicated they would continue with those safety plans after the pandemic was under control.[13] Other workplace responses to the pandemic included changing staff schedules, allowing staff to work from home, and making changes to emergency response plans or protocols. Fewer than 15 per cent of respondents indicated that there had been suspected COVID-19 transmission at their facility, and approximately 45 per cent reported that their organization provided additional benefits to aid staff in dealing with the pandemic.[13] Most respondents (almost 80 per cent) felt that the changes in operations would not have long-term implications for their facility.[13]

When asked what additional supports they would have appreciated from the EOCP and government during the pandemic, survey respondents suggested:

- Creating a mutual aid framework for operators so that they can request help or offer it to others; and
- Having increased regulation and enforcement of water system supply operations, including to protect worker health and safety.[13]

Survey respondents also shared some of what they had learned while working through the pandemic:

- They were unprepared for the pandemic and required pandemic kits similar to earthquake kits. It was difficult to get masks, isopropyl alcohol, sanitizing wipes, etc., in the first six months of the pandemic.
- They realized the importance of planning, preventive maintenance, and being prepared (e.g., having extra chemicals on hand for increased cleaning and disinfection).
- The workload of water system operators increased substantially during the pandemic, but compensation did not.
- Water system staffing shortages made the whole system vulnerable. One unexpected illness could shut down plant operations.[13]

Message from the Environmental Operator Certification Program

Throughout the COVID-19 pandemic, our certified environmental operators have worked diligently across the province to ensure that safe water was available for washing our hands, and have been involved in wastewater screening to determine the presence of the coronavirus in communities. Indeed, at some facilities, trailers were brought in to house operators onsite in the event of an outbreak in their communities so that the provision of safe drinking water and wastewater management could continue without interruption.

Kalpna Solanki, MBA, BSc, CPHI (C)
President and CEO
Environmental Operators Certification Program[14]

Okanagan College students continuing their studies for becoming certified environmental operators during the pandemic by accessing virtual classes and following COVID-19 safety measures.

Photo credit: Kalpna Solanki, Environmental Operator Certification Program President and CEO.

9.1.3 Water Sampling and Laboratory Testing

Lack of access to PHO-approved laboratories for routine water quality testing, often due to courier and transportation challenges, has been a challenge for some rural/remote communities in every regional health authority,[15] but the COVID-19 pandemic made these issues worse. Flight cancellations and courier service interruptions related to the pandemic made it difficult for some areas of the province, including much of the north, to get water samples to an approved laboratory for testing within the required 30-hour time frame.[16] For example, Interior Health reported the loss of an entire batch of East Kootenay water system drinking water samples when the flight BCCDC PHL used to ship the samples was cancelled.[17]

Other regional health authorities also reported courier and transportation problems. Island Health reported issues with bacteriological sampling and courier services for the North Island (north of Campbell River).[18] At the beginning of the pandemic, Vancouver Coastal Health indicated that the lack of couriers to transport water samples was a concern in the Sea-to-Sky corridor and on the Sunshine Coast.[11] Sampling difficulties also occurred in more remote areas of Vancouver Coastal Health, such as the Central Coast. These difficulties were related primarily to PHO- and/or government-issued travel restrictions, to the cancellation of flights that were usually used to transport water samples from remote communities, and to the closure of some First Nations territories to non-residents.[11] While a chartered essential services flight continued to provide access to remote Vancouver Coastal Health communities that had hospitals, such as Bella Bella and Bella Coola, Anahim Lake's nursing station was not included, so water samples could not be transported out of that area to an approved laboratory.[11]

The number of late water sample shipments received by the BCCDC PHL is a reflection of the courier and transportation problems caused by the pandemic. In the last quarter of 2020, the BCCDC PHL reported that the number of late shipments more than doubled compared to the same quarter in 2019.[19] As reported in Section 6.3 (Chapter 6), the number of water samples sent to the BCCDC PHL decreased by 13 per cent in 2020/21 compared to the previous fiscal year. This is related to both transport challenges and reduced sampling.

Regional health authorities also had difficulty collecting water samples. For example, Fraser Health found that early in the pandemic, some small water system operators were hesitant to submit routine water quality monitoring samples due to personal safety concerns related to the risk of COVID-19 transmission.[10] Also, the way in which physical distancing guidelines were implemented limited or restricted access to water sampling sites in private homes and buildings due to disease transmission concerns. Similarly, Northern Health reported that couriers were sometimes reluctant or refused to enter water sample drop-off locations due to concerns about contracting COVID-19, and that business slowdowns and closures resulted in sampling being drastically reduced or abandoned.[7]

9.1.4 Certification of Laboratories for Drinking Water Testing

PHO- and/or government-directed travel restrictions and reduced availability of flights due to the pandemic also affected the ability of the Enhanced Water Quality Assurance (EWQA) Program (see Section 6.3.1 [Chapter 6]) to certify laboratories for drinking water testing.

Due to the challenges of COVID-19, the EWQA Program cancelled onsite laboratory audits in July 2020.[20] This applied to existing approved laboratories and new laboratories that were undergoing the approval process, and was based on factors such as travel restrictions and the reduced availability of flights and volunteer auditors.[21] To lessen the impact of cancelling onsite audits, EWQA granted temporary extensions to laboratories whose certificates expired in 2020[21] and replaced onsite laboratory audits with virtual audits.[22,23] The virtual audit process is discussed in more detail in Section 9.2.7.

9.1.5 First Nations Communities

Like the regional health authorities, FNHA reported that water sampling during the pandemic was challenging due to restricted access to First Nations communities, implementation of physical distancing practices due to COVID-19 transmission concerns, and limitations in transporting water samples.

Access to some First Nations was restricted because they closed their territories to non-residents to ensure community safety.[11] As a result, EHOs were not able to conduct regular onsite risk assessments of drinking water systems and had to conduct them virtually.[24] Circuit Riders[d,25,26] were also restricted access to communities, even though they play a large role in ensuring drinking water safety.[24]

Implementation of physical distancing practices due to COVID-19 transmission concerns also affected the number of water samples community-based water monitors (CBWMs)/operators could collect. CBWMs sample and test drinking water for potential bacteriological contamination as a final check of the water at the tap.[27] However, CBWMs did not enter homes, where many sample sites are located, to respect physical distancing requirements.[28] Some new CBWMs lacked confidence in carrying out their sampling program without support.[24] Also, some CBWMs/operators went into self-isolation (e.g., due to illness or contact with a COVID-19 case); therefore, monitoring of their assigned drinking water systems ceased.[28] FNHA advised one system to issue a precautionary advisory due to the lack of monitoring activities.[24]

FNHA also noted that courier service issues impacted the timely delivery and processing of drinking water samples.[28] In some cases, water equipment and supplies that were sent to communities went missing or could not be delivered due to facility closures or limited hours of operation.[28] Equipment and supply delivery failure led to gaps in sampling and wasted time and money.[24] However, FNHA reported that these delays have been resolved.[28]

During the pandemic, communication with First Nations offices and CBWMs/operators was challenging. Many First Nations have limited or no cell phone coverage, so the only way to

[d] Circuit Riders are professionals who support First Nations communities in the management of on-reserve drinking water and wastewater systems. Circuit Riders travel between communities and provide technical and operational expertise, training, troubleshooting, and other assistance with on-reserve water system monitoring and maintenance.

contact people is by calling the band office or sending emails. Because public buildings were closed for months, communication was limited. Many communities were overwhelmed with COVID-19 information and response.[24] Some First Nations reported staff shortages, including cases where both the CBWM and backup staff were off work.[24] As a result, EHOs often could not reach those individuals who were operating or monitoring water systems.

9.1.6 Small Water Systems and Rural and Remote Regions

The unanticipated consequences of COVID-19 response measures, such as staff shortages, flight cancellations, and courier service disruptions, have disproportionately affected small water systems and rural and remote communities. These issues were highlighted by Interior Health and Northern Health.

Interior Health emphasized that service impacts were more severe for small community water systems compared to large water systems across the health authority.[8] For example, EHOs were unable to hold normally scheduled peer-to-peer training sessions for small water system operators to support improved operations. Interior Health also fell short of its targets to inspect small water systems and update core information within their data system. Forty-three per cent of small community water system files were missing core facility information by 2020/21.[8]

EHO inspections of small water systems in Northern Health were limited during the pandemic to ensure the safety of staff and clients. The inspections that were conducted tended to focus on clusters of systems that were easy to access. More remote areas, which are typically inspected by two EHOs for safety and security reasons, became more difficult to access (due to staffing reductions, physical distancing requirements, and additional coordination required for safe travel arrangements).[7] Travel to some remote locations was halted, and many difficult-to-reach locations were not serviced. Northern Health also reported that supply chain issues caused delays in some small water system infrastructure projects.[7]

In Vancouver Coastal Health, drinking water programs in the Central Coast and West Chilcotin areas experienced the greatest sampling challenges due to COVID-19, but some concerns in the Sea-to-Sky corridor and the Sunshine Coast were also noted.[11] These issues were related mainly to travel restrictions and the cancellation of flights that were used to transport water samples. Although these issues were resolved in three of four affected communities, no reliable, economical means of transporting routine water samples from the Anahim Lake area to the BCCDC PHL was found.[11] Territorial closures by the Nuxalk and Heiltsuk First Nations also affected drinking water programs. For example, the closure of the Heiltsuk territory (which includes the Bella Bella airport and ferry terminal) to non-residents made access to the neighbouring communities of Denny Island and Ocean Falls difficult.[11] Aside from sampling issues, Vancouver Coastal Health reported few impacts to small water systems due to COVID-19.[11]

Unlike other health authorities, Fraser Health and Island Health found no evidence that any water system had been disproportionately affected by COVID-19 within their regions.[10]

9.1.7 Other Issues

Additional impacts to drinking water systems during the pandemic included changes in water demand, water stagnation in unoccupied buildings, supply chain issues, and delays in infrastructure funding and water system improvements.

With the closure of businesses, offices, and schools, water demand and use patterns within community water systems changed. The Capital Regional District (CRD),[e] which supplies drinking water to the Greater Victoria region, analyzed billing data and changes in drinking water demand patterns for the first six months of the pandemic after operating businesses were reduced to essential services only, in-classroom learning and child care were limited, and residents were encouraged to work from home. During the first two months of COVID-19 response measures (March and April 2020), the region recorded an overall increase in water demand while the strictest stay-at-home measures were in place, likely due to an increase in cleaning, hand washing, and toilet flushing from residents sheltering and working at home.[29] From May to June 2020, total regional water

[e] The Captial Regional District is located in the traditional territory of the Lək̓ʷəŋən (Songhees) and Xwsepsum (Esquimalt) Nations, the W̱SÁNEĆ Nations {WJOŁEŁP (Tsartlip), BOḴEĆEN (Pauquachin), SṮÁUTW̱ (Tsawout) W̱SIKEM (Tseycum)}, Sc'ianew, T'Sou-ke, Pacheedaht, and MÁLEXEŁ (Malahat).

A potable water treatment system (above) within a grocery store in the City of Vancouver falls under the definition of a building system. Under the Drinking Water Protection Regulation, building systems are defined as water systems within a building, to which the BC Plumbing Code applies. Building systems receive water from a water supply system that has been issued an operating permit under the *Drinking Water Protection Act*. As a result, building systems are exempt from the definition of a domestic water system and do not require an operating permit under the Act. During the COVID-19 pandemic, there were concerns about potential water stagnation within large building systems where occupancy had declined due to the implementation of COVID-19 safety measures.

Photo credit: Chris Radziminski, CWP, Building Policy Engineer, City of Vancouver.

demand declined, which the CRD attributes to a decrease in water use in several commercial and industrial sectors, and to fewer visitors to the region. For example, during this period, the average water demand decreased by 9 per cent in the retail sector, 27 per cent in restaurants and pubs, and 31 per cent in schools compared to previous years. In contrast, the largest overall increase in water demand (13 per cent) occurred in care facilities, whereas the demand in hospitals dropped in the first few months, possibly due to the cancellation of elective and non-emergency surgeries.[29] By late summer, the total regional water demand began to increase again as more businesses began reopening. Overall, taking temperature and precipitation patterns into account, a net reduction of 6 per cent in total water demand in the region occurred during those first few months of the pandemic relative to previous years.[29]

During the pandemic, many large buildings (such as offices, stores, restaurants, and schools) were underused or unused, so drinking water sat stagnant in building pipes. Vancouver Coastal Health was concerned that the prolonged closure or reduced occupancy of these large buildings could result in stagnant water becoming contaminated with microbial growth, leaching from lead or copper pipes, or by-products from the disinfection process. Although water distribution systems in buildings are exempt from the *Drinking Water Protection Act* and the responsibilities of an EHO, it is important for health authorities to address water quality issues that result from stagnant water in building pipes because they can lead to illness or harm.[30] Vancouver Coastal Health's approach to dealing with stagnant water in large buildings is discussed in Section 9.3.5.

Some regional health authorities stated that supply chain issues were a pre-existing risk for drinking water systems that were exacerbated by the pandemic. For example, Island Health indicated that on the Gulf Islands, which rely largely on the ferry system, drinking water systems were subject to supply chain vulnerabilities.[18] In Northern Health, a new drinking water treatment plant project was delayed due to COVID-19-related supply chain issues because the facility did not receive the filters it required from a company in the United States. This delay affected the facility's ability to meet the microbiological drinking water treatment objectives for BC.[31]

Additionally, some planned water system infrastructure upgrades were delayed due to the pandemic. Some water system owners found that the costs of resuming work on system upgrades, such as material and/or shipping costs, were much higher than the initial quote they had received before the pandemic. For example, Northern Health noted that one system reported a 33 per cent increase in infrastructure upgrade costs from the original quote.[7]

9.2 Provincial Mitigation Strategies

Throughout the pandemic, the PHO and the Ministry of Health worked with the regional health authorities and industry partners (such as the EOCP) to develop provincial mitigation strategies to address COVID-19 impacts that drinking water system operators faced.[2] The strategies included ensuring clear, consistent communication with operators and the public, and modifying water quality sampling and testing processes and operations to meet the guidelines and direction of public health officials.

Temporary Measures to Ensure Continuity of Operations for Water Systems

On April 9, 2020, the Provincial Health Officer (PHO) sent a letter to water suppliers that outlined temporary measures they should take during the public health emergency and provincial state of emergency to ensure continuity of water system operations, including the following:

- Establish flexibility to employ and redeploy qualified operators as needed to address staff shortages, to reschedule operator hours, and to use operators whose certification may have expired within the previous three years.
- Temporarily employ other qualified individuals (i.e., knowledgeable technical personnel and supervisors, managers, professional engineers, technologists, and operators) to perform operational duties.
- For any Level I to IV water systems that required Environmental Operator Certification Program (EOCP)-certified operators, the EOCP's Operator Peer Network program was suggested as a source of appropriately certified operators.
- Small water systems that do not require EOCP certification may train others in the basic operation of systems in case the person running the system is unavailable.

The letter also advised drinking water systems owners to:

- Update emergency response and contingency plans and review staffing coverage procedures to plan for staff absences due to illness or self-isolation.
- Consider mutual aid agreements with neighbouring suppliers to ensure that drinking water services could be maintained.
- Identify priority actions to be taken in the event of a reduced workforce and create operations teams that provide a mixture of skills required to operate the water system.
- Ensure written standard operating procedures are detailed and easy enough to follow so junior staff can carry out duties not normally assigned to them.
- Consider postponing new non-critical projects to ensure tasks essential to delivering potable water can be carried out.[32]

To ensure clear, consistent information was provided to all interested parties, the PHO also sent the letter to the regional health authorities, the EOCP, and the BC Water and Waste Association.

9.2.1 Communication

Clear, consistent communication between the PHO and the regional health authorities, drinking water system operators, and industry partners was essential throughout the pandemic. Communication strategies included developing messaging for water system operators that emphasized the need to have updated emergency response and contingency plans in place, and communicating other measures operators could take to ensure the continuity of water systems operations (see text box above).[2] The regional health authorities also developed consistent messaging (e.g., responses to frequently asked questions) for the public that reassured them that drinking water safety remained a top priority, and that advised them who to contact with concerns. As several regional health authorities affirmed, these lines of communication were critical in ensuring that drinking water programs could continue throughout the pandemic.

9.2.2 Water Sampling and Laboratory Testing

With the support of the PHO, the BCCDC PHL and the regional health authorities implemented several strategies to mitigate the impacts of COVID-19 on water sample delivery and testing, including modifying water sample testing procedures, using alternative transportation to deliver water samples to approved laboratories, using previously non-subcontracted laboratories (i.e., Wellness Water Testing Laboratory Inc. in Prince George) to assist with drinking water sample testing, and ensuring that laboratories that test drinking water samples continue to be certified by the EWQA Program using a virtual audit process.

9.2.3 Modified Water Sample Testing Procedures

Typically, drinking water samples that do not arrive at a PHO-approved laboratory within 30 hours of being collected will not be tested

because a prolonged hold time may impact sample integrity. However, during the pandemic, the BCCDC PHL contacted the health authorities to gain approval to process late samples (those that arrived beyond the accepted 30-hour time frame but within 48 hours of being collected) for qualitative (positive/negative) verbal reporting until resampling could be conducted and the samples could be processed within the 30-hour time frame.[19] Northern Health and Vancouver Coastal Health pre-approved this process to help address courier challenges.[15] The other regional health authorities also adapted water sample testing procedures due to transport impacts from the pandemic.

9.2.4 Alternative Transportation

The BCCDC PHL attempted to arrange alternative courier networks to transport drinking water samples along with the daily SARS-CoV-2 virus test samples being arranged by the Emergency Operations Centre and Health Emergency Management BC. Unfortunately, this strategy was not effective in remote areas because it was difficult to coordinate sample exchange between clinical laboratory staff and environmental health protection staff.[15] The BCCDC PHL also developed ground transport contingency plans with PHO-subcontracted laboratories to help support water sampling and shipment in flight-dependent locations in the Northern Health and Interior Health regions. Fortunately, shipments to these laboratories by ground was minimally impacted. The combination of support from PHO-subcontracted laboratories and ground transport access allowed the BCCDC PHL to provide continuity of water quality testing in those communities.[15]

9.2.5 Alternative Laboratories

The BCCDC PHL also asked laboratories that did not have an existing contract with it to undertake drinking water testing. This was an effective strategy to ensure sample testing continued. For example, before the pandemic, water samples from Fort Nelson and Burns Lake were transported to the BCCDC PHL by air. However, these flights were discontinued during the pandemic, and flight schedules have not returned to pre-pandemic levels. The only alternative was to send samples by ground transportation to an EWQA-approved lab in Prince George.[15]

Surplus pallets of water sampling supplies line the hallways of the BC Centre for Disease Control. Both the pandemic and climate-related emergencies during the reporting period contributed to significant transportation network challenges and disruptions to supply chains for testing reagents and plastics that laboratories require for testing drinking water. As a result, laboratories had to stockpile supplies in case shipments were delayed or supplies became unavailable.

Photo credit: BC Centre for Disease Control Public Health Laboratory.

9.2.6 Point-of-use Testing

In consultation with the PHO, the BCCDC PHL set up remote point-of-use testing (POUT) in parts of the province where courier services and alternative transportation arrangements were unavailable due to the pandemic.[15] POUT uses specialized equipment to test water samples for coliform and *E. coli*. These tests can be conducted at non-laboratory locations, such as health units, and can be performed by non-laboratory personnel who have appropriate authorization and training. During the pandemic, POUT was implemented across Northern Health, Interior Health, and Vancouver Coastal Health as an "emergency deployment" initiative and included remote environmental microbiology training for environmental health officers.[15] However, for POUT to be fully operationalized in these health regions, additional staffing, and reagent resources and/or funding would be required.[33] Fraser Health or Island Health did not request emergency deployment support.[15]

The BCCDC PHL indicated that the deployment of POUT supplies to health units at the beginning of the pandemic was effective for those health authorities that had the capacity to conduct tests (i.e., Northern Health and Vancouver Coastal Health), but it was not effective when staff became unavailable (e.g., due to redeployment).[15] The BCCDC PHL's request to FNHA (which uses the same POUT system as the BCCDC PHL) to support water sample testing was not effective because EHOs were unable to enter First Nations communities due to physical distancing requirements and/or to First Nations closing their territories to non-residents.[15] Deployment of POUT "starter packages" by the BCCDC PHL to health units that did not have the equipment before the pandemic would have been effective, but the regional health authorities indicated they had limited or no staff to perform the tests.[15]

9.2.7 Enhanced Water Quality Assurance Program Virtual Audits

Due to the challenges of the COVID-19 pandemic, the EWQA Program cancelled onsite laboratory audits in July 2020.[21] This applied to existing approved laboratories and new laboratories that were undergoing the approval process, and was based on factors such as travel restrictions and the reduced availability of flights and volunteer auditors who could travel to conduct audits.[21]

To lessen the impact of cancelling onsite audits, EWQA began conducting virtual laboratory audits. As a result, the EWQA team had to consider appropriate policy and guidance for auditors and laboratories, technological requirements for conducting virtual audits, the audit format, and how to assess audit elements virtually.[34]

To support virtual audits, EWQA prepared a policy and guidance document for auditors and audited laboratories. The EWQA Program also developed a questionnaire to gauge each laboratory's technological readiness for a virtual audit.[35] Laboratory owners were asked for information about their Internet, Wi-Fi, and videoconferencing capabilities[35] so the audit team could assess the feasibility of conducting virtual audits.

Before the pandemic, EWQA staff took several hours to prepare for an onsite audit and one full day (six to eight hours) to complete it.[34] EWQA determined that a full-day virtual audit was not practical.[34] Instead, it adopted a two half-day format with each session lasting two to three hours.[23] Tasks completed during the audit included:

- a virtual facility tour;
- document review (e.g., quality control logs, equipment certification, and staff training records);
- sample setup demonstration;
- sample reading and reporting; and
- a laboratory safety and equipment review.[23]

EWQA staff assessed components of the audit by virtual, live observation[34] (e.g., a facility tour or equipment demonstration): one staff member would hold the camera steady while the other demonstrated the tool or procedure for the audit team.[23]

In July 2020, the EWQA Program notified established PHO-approved laboratories of the cancellation of onsite audits due to COVID-19. Three PHO-approved laboratory audits were postponed in 2020 and rescheduled to June 2021.[36] Subsequently, the 2021 audits were moved to early 2022.[34] See *Table 6.5* (Chapter 6) for a list of virtual audits completed in 2021 and 2022. The EWQA Program reported that the laboratories' feedback on the virtual audit process was positive.[36]

9.3 Regional Health Authority and Water Supplier Mitigation Strategies

In addition to the province-wide mitigation strategies that were implemented, individual health authorities and water suppliers implemented regional and smaller scale strategies and activities to ensure drinking water safety and quality was maintained throughout the pandemic and through the challenges posed by floods and wildfires. These strategies addressed staffing shortages, water sampling and lab testing, small water systems, communication with water suppliers, and reopening guidelines for buildings.

9.3.1 Staffing

Interior Health, Island Health, and Northern Health adopted strategies to deal with staffing shortages. Interior Health's drinking water systems program team was successful in coordinating and focusing resources to maintain critical emergency (e.g., water system infrastructure failures) and complaint response and investigation services in 2020/21.[8] The team also met inspection targets for large water systems in Interior Health by completing full inspections of 33 large water suppliers. However, proactive regulation and services for small water systems were significantly restricted. To cope with COVID-19-related staffing shortages, Island Health altered district areas to ensure coverage was available for permitting approvals, complaints, emergencies, and other demand-driven work, and hired five new full-time EHOs; however, most of those positions were required for pandemic response.[12] Island Health also altered EHOs' working hours/schedules to ensure coverage for pandemic response throughout the week.[12] Northern Health developed central intakes, triage, and dissemination processes to prioritize responses to drinking water system queries based on risk and to ensure an equitable response across the health authority. Northern Health also provided virtual inspections and removed assigned inspector districts to cope with staff shortages.

9.3.2 Water Sampling and Laboratory Testing

Some regional health authorities adopted strategies to deal with water sampling and laboratory testing challenges, including:

- Training EHOs to receive and analyze water samples (using POUT) from water system operators who could not access PHO-approved laboratories;[7]
- Changing sampling routines;[37]
- Arranging alternative laboratories to conduct water sample testing;[7] and
- Arranging alternative transportation.[7]

Using these approaches, the regional health authorities supported drinking water testing during the pandemic. Unfortunately, due to staffing shortages, they could not offer POUT to system operators.

9.3.3 Small Water Systems

To help small water system operators cope with the loss of service, Interior Health's drinking water systems program continued to support the development and operation of the British Columbia Small Water Systems Online Help Centre.[8] Interior Health also supported the Okanagan Basin Water Board in implementing community water source protection tools and worked with the BCCDC PHL to find solutions to water sample transportation and courier issues.[8]

9.3.4 Communication

The provision of clear, consistent, and timely information from the regional health authorities to drinking water system operators was crucial to delivering safe drinking water to the public during the pandemic. Regional health authorities used different methods to communicate with operators in their regions. FNHA sent letters to communities to advise them about water safety issues related to COVID-19 and the continued use of water for sanitation purposes.[37] At the beginning of the pandemic, Island Health contacted all water system operators directly to provide information (e.g., instructions for cleaning and sanitizing frequently touched surfaces in workplaces) and identify areas of need regarding emergency response and contingency plans for the systems.[12] Island Health reminded operators to have communication plans to inform their users in case potable water requirements could not be met, to ensure bacteriological sampling requirements were met, and to contact their district DWO about any emergency that could impact the water supply.[12]

In Northern Health, EHOs called drinking water system operators and advised them to stock up on supplies because shortages and delivery issues were expected.[7] Northern Health also sent system operators an email about COVID-19, along with advice for taking action to prevent impacts to water systems from COVID-19.[7] Vancouver Coastal Health directly contacted operators of larger water systems, such as Metro Vancouver, to provide COVID-19 information. The health authority also developed a summary document to send to operators of smaller systems and to post on its website. This information was well received by water system operators.[11] The BC Water and Waste Association also posted information on its website about COVID-19 and drinking water and wastewater safety for operators.[38]

9.3.5 Reopening Guidelines for Buildings

As a result of the potential for stagnant water in vacant or underused buildings to cause illness, Vancouver Coastal Health created a building reopening document, which was posted on its website and was shared with other regional health authorities.[39] The document included guidance on flushing pipes and fixtures, and recommended that water system operators increase the free available chlorine within their distribution system to help neutralize any buildup of microbial growth in building systems.[11] This recommendation was discussed with Metro Vancouver water system operators, who decided that elevating the free available chlorine levels in the municipal distribution system was appropriate; therefore, they raised the free available chlorine in the water that was delivered to municipalities and cities for a number of weeks.[11] The Canadian Water and Wastewater Association also developed reopening guidelines for buildings as a resource to assist operators.[40]

9.3.6 Water Suppliers

Drinking water system operators adopted various strategies to ensure water systems were appropriately staffed and operated during the pandemic. In Northern Health, drinking water system staffing issues were minimized by sharing EOCP-certified operators among systems. Additionally, if a water system operator was required to self-isolate, they provided operational advice to coworkers from home.[7] Vancouver Coastal Health reported that larger systems developed procedures to ensure staff complied with COVID-19 safety plans. Some systems also had plans for staff to remain at the jobsite if the next shift was unable to attend work due to illness.[11] Fraser Health noted that most permitted water systems were able to maintain normal operations; therefore, no further mitigation measures were required.[10]

Island Health reported that the Capital Regional District's emergency response and contingency plan included procedures to ensure that adequate certified staff were available and could be redeployed as necessary, cross-training of staff was conducted to ensure the treatment plant continued to operate, weekly check-ins were held with distributors to ensure water supplies were adequate, enhanced sanitization procedures were used, and all contact information in the district's plans were up to date and accurate.[12]

These steps taken by the regional health authorities and water suppliers helped ensure that potable water could continue to be delivered to the public during the pandemic.

9.4 Ongoing Concerns and Next Steps

The regional health authorities and industry put several mitigation strategies in place to ensure potable water was delivered during the pandemic; however, as of March 31, 2021, the regional health authorities had expressed ongoing workload and staffing concerns, and suggested several next steps to address them.

9.4.1 Ongoing Concerns

Interior Health indicated that it was not clear how disruptions from the COVID-19 pandemic would affect improvements to community drinking water systems. However, it felt that the backlog in inspections for small systems would challenge the drinking water program in achieving provincial expectations for reporting, including meeting the new PHO recommendation for reporting by 2024.[8]

Interior Health's Environmental Public Health and Licensing team continued to develop and adapt its transition and recovery plan as the COVID-19 pandemic evolved, but the health authority said that a full assessment of the challenges it faced and the solutions it adopted could be made only when the pandemic response was over

and interested parties had an opportunity to share their thoughts and experiences. Interior Health suggested that additional actions and resources may be needed to manage its drinking water systems program, which could include reviewing the pay structure for EHOs to retain staff,[8] hiring technicians to assist with the program, and providing further education and support to staff. As of March 31, 2021, Interior Health's drinking water systems program staff had begun discussing with its medical health officers' team the need for additional resources for small water system inspections, operator training, compliance activities, and information management improvements.[8]

Northern Health also indicated that staff recruitment and retention should be made a priority, particularly in more rural and remote areas of the province. The health authority also identified the provision of in-person water system operator training as an ongoing gap in its region. In-person training courses are offered only in the Lower Mainland, and although Northern Health could provide these courses, it does not have sufficient staff to do so.[7]

Vancouver Coastal Health noted that poor water quality in closed buildings will continue beyond the end of the pandemic. While this is not necessarily a DWO responsibility, the health authority indicated that someone needs to communicate the risks associated with stagnant water in building systems (and methods to reduce those risks) to building managers and maintenance personnel.[11]

9.4.2 Next Steps

To deal with ongoing workload and staffing concerns, the regional health authorities, BCCDC PHL, and EOCP proposed several actions and initiatives. Some regional health authorities suggested catching up on missed inspections;[7] another proposed evaluating the impact the COVID-19 pandemic had on water systems.[10] Other health authorities were unsure what further steps or support would be needed to address ongoing or future unintended consequences of the pandemic.[12]

The BCCDC PHL recommended the following next steps for routine drinking water testing, POUT, and the EWQA Program:

- Develop improved communication with Health Emergency Management BC to access emerging transport support for drinking water testing. This includes better communication of the essential nature of drinking water testing, and better coordination and communication processes between environmental health protection staff and clinical laboratory staff at water sampling pickup and drop-off points to ensure the transport of samples to Vancouver.
- Complete the POUT pilot study and implement the POUT program using the BCCDC PHL and regional health authority resources.
- Support a fully resourced POUT program for both routine and emergency response.
- Provide further support to the EWQA Program and increase the number of EWQA-approved laboratories in remote locations in BC.
- Pursue locally sourced couriers and continued accountability for courier service issues.[15]

EOCP members suggested that a drinking water system mutual aid framework be created.[13] In response, the EOCP proposed developing Emergency Response Teams. The teams would be established in seven locations across BC (Nanaimo, Vancouver, Kelowna, Cranbrook, Smithers, Prince George, and Fort St. John)[41] and would include designated team leads with expertise in incident command systems, a trained response team, and a trailer outfitted with equipment.[41] Emergency Response Teams could be deployed quickly during emergencies and would include members who had knowledge of the facilities within their area and of the maintenance of water and wastewater infrastructure.

The COVID-19 pandemic and public health response measures had dramatic impacts on drinking water programs across BC. These impacts continue to be felt, particularly in more rural and remote areas and by smaller water systems. This chapter outlines the needs and insights shared by the BCCDC PHL, EOCP, FNHA, and regional health authority partners in addressing these impacts, both during the pandemic and in the longer term.

REFERENCES

[1] BC Office of the Provincial Health Officer. COVID-19 (novel coronavirus) [Internet]. Victoria, BC: BC Office of the Provincial Health Officer; [updated 2022 Apr 20; cited 2022 May 02]. Available from: *https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/current-health-topics/covid-19-novel-coronavirus*.

[2] Office of the Provincial Health Officer. Temporary measures to ensure continuity of operations for water systems in British Columbia under the *Drinking Water Protection Act* [Memorandum from B Henry]; 2020 Apr 09.

[3] Office of the Provincial Health Officer. Essential service – water quality testing under the *Drinking Water Protection Act* [Memorandum from B Emerson]; 2020 Mar 19.

[4] Office of the Provincial Health Officer. Temporary measures to ensure continuity of operations for water systems in British Columbia under the *Drinking Water Protection Act* [Memorandum to drinking water systems owners, regional health authorities, and Environmental Operators Certification Program]; 2020 Apr 09.

[5] Wadden S. Personal communication. Northern Health; 2020 May 27.

[6] Regional Health Authorities. Response to request for updates to the status of drinking water in British Columbia, 2021.

[7] Northern Health Authority. Response to request for updates to the status of drinking water in British Columbia 2021 [email from J Green]; 2021 Jun 30.

[8] Interior Health Authority. Response to request for updates to the status of drinking water in British Columbia 2021 [email from JI Norlin]; 2021 Sep 07.

[9] Zimmerman C. Personal communication. Interior Health; 2022 Mar 03.

[10] Fraser Health Authority. Response to request for updates to the status of drinking water in British Columbia 2021 [email from B Choquette]; 2021 Jul 07.

[11] Vancouver Coastal Health Authority. Response to request for updates to the status of drinking water in British Columbia 2021 [emails from P Muirhead]; 2021 Jun 24, 2021 Jul 08.

[12] Island Health Authority. Response to request for updates to the status of drinking water in British Columbia 2021 [email from R Beise]; 2021 Jun 29.

[13] Environmental Operators Certification Program. Response to request for EOCP updates 2021 [email from K Solanki]; 2021 May 18.

[14] Solanki K. Personal communication. Environmental Operators Certification Program; 2021 Apr 06.

[15] BC Centre for Disease Control Public Health Laboratory. Response to request for updates to the status of drinking water in British Columbia 2021 [email from C Tchao]; 2021 Jul 16.

[16] BC Centre for Disease Control Public Health Laboratory. Contingency plans for interruptions of courier services for water quality testing [email from N Prystajecky]; 2020 Mar 19.

[17] Interior Health Authority. RE: COVID-19 reduction of the certification/training requirements of water/waste systems: prov update [email from JI Norlin]; 2020 Mar 30.

[18] Island Health Authority. RE: COVID-19 reduction of the certification/training requirements of water/waste systems: prov update [email from R Beise]; 2020 Mar 30.

[19] BC Centre for Disease Control Public Health Laboratory. BCCDC Public Health Laboratory courier update [email from C Tchao]; 2020 Dec 16.

[20] BC Centre for Disease Control. EWQA onsite audits - postpone June audits [email from C Lee]; 2020 Mar 27.

[21] Enhanced Water Quality Assurance. Extension of cancellations of EWQA onsite audits in 2020 [Memorandum from M Krajden]; 2020 Jul 03.

[22] BC Centre for Disease Control. Invitation to Caleb Lee's Zoom Meeting - virtual audit discussion [email from C Lee]; 2021 Feb 03.

[23] Enhanced Water Quality Assurance. EWQA virtual audit policy and guideline. Vancouver, BC: BC Centre for Disease Control Public Health Laboratory; 2020.

[24] First Nations Health Authority. RE: Access to safe water [email from R Fleming]; 2020 May 28.

[25] Office of the Provincial Health Officer. Clean, safe, and reliable drinking water: an update on drinking water protection in BC and the action plan for safe drinking water in British Columbia. Provincial Health Officer's drinking water report: 2012/13-2016/17. Victoria, BC: BC Office of the Provincial Health Officer; 2019.

[26] Indigenous Services Canada. Circuit Rider Training Program [Internet]. Ottawa, ON: Government of Canada; [cited 2022 May 03]. Available from: *https://www.sac-isc.gc.ca/eng/1313424571273/1533818103401*.

[27] Government of Canada. Drinking water monitoring: Indigenous Services Canada's role. [Internet]. [cited 2022 July 11]. Available from: *https://www.sac-isc.gc.ca/eng/1562866127080/1562866152629*.

[28] First Nations Health Authority. RE: Access to safe water [email from R Fleming]; 2020 May 26.

[29] Capital Regional District. Review of the 2020 residential and industrial commercial /institutional demand during COVID-19. Victoria, BC: Capital Regional District; 2020 Sep 22.

[30] Canadian Water and Wastewater Association. Safely re-opening buildings: fact sheet for building owners/operators. [Internet]. Ottawa, ON: Canadian Water and Wastewater Association; 2020 May [cited 2022 May 03]. Available from: *https://cwwa.ca/covid-19-and-the-re-opening-of-buildings/*.

[31] Northern Health Authority. Response to request for updates to the status of drinking water in British Columbia 2021 [email from S Wadden]; 2022 Jul 08.

[32] Office of the Provincial Health Officer. Temporary measures to ensure continuity of operations for water systems in British Columbia under the *Drinking Water Protection Act* [Memorandum to drinking water systems owners, regional health authorities, and Environmental Operators Certification Program]; 2020 Apr 09.

[33] Quibell, D. Personal communication. Northern Health Authority. 2023 Jul 28.

[34] Enhanced Water Quality Assurance. EWQA virtual audit: remotely assessing laboratory performance. Vancouver, BC: BC Centre for Disease Control Public Health Laboratory; 2020.

[35] Enhanced Water Quality Assurance. EWQA virtual audit questionnaire. Vancouver, BC: BC Centre for Disease Control Public Health Laboratory; 2020.

[36] Enhanced Water Quality Assurance. Response to request for updates to the status of drinking water in British Columbia 2021 [email from C Lee]; 2021 Jul 07.

[37] First Nations Health Authority. Response to request for updates to the status of drinking water in British Columbia 2021 [email from R Fleming]; 2020 May 26.

[38] BC Water and Waste Association. COVID-19 resources. [internet] [cited 2022 August 30]. Available from: *https://bcwwa.org/site/resources/issues/covid19?nav=sidebar*.

[39] Vancouver Coastal Health Authority. Coronavirus disease (COVID-19): guidance for building water systems (version 2). [Internet]. Vancouver, BC: Vancouver Coastal Health Authority; 2020 Sep 08 [cited 2022 May 10]. Available from: *https://www.vch.ca/en/media/8966*.

[40] Canadian Water and Wastewater Association. Safely re-opening buildings: general guidance for water utilities. [Internet]. Ottawa, ON: Canadian Water and Wastewater Association; 2020 May [cited 2022 May 03]. Available from: *https://cwwa.ca/covid-19-and-the-re-opening-of-buildings/*.

[41] Environmental Operators' Certification Program. Disasters within disasters. Burnaby, BC: Presentation; 2022 Jun 23.

CHAPTER

10 Climate-related Events and Drinking Water

There is now strong evidence that the effects of climate change, such as rising temperatures, changing precipitation patterns, more frequent and severe extreme weather events, and rising sea levels can adversely affect water quality and quantity, and disrupt drinking water systems by causing water contamination and/or damage to drinking water infrastructure.[1] For example, rising sea levels may result in saltwater intrusion and contamination of drinking water sources.[2] Increasing water temperatures create favourable conditions for the growth of cyanobacteria and waterborne pathogens, and heavy precipitation events can lead to increased microbial concentrations in drinking water.[1] BC is also experiencing severe drought conditions in multiple regions of the province, which impact drinking water reserves.

Impacts on drinking water systems have already occurred in BC, and as the climate begins to warm and the frequency and severity of climate events increases, so will risks to health due to impacts on drinking water systems. However, a coordinated, collaborative, and cross-sector approach to preparing for, and responding to, these events will reduce the health risks associated with impacts on drinking water due to climate change and will build resilient drinking water infrastructure.[1]

This chapter focuses on climate-related events (floods, extreme heat, cold temperatures, drought, and wildfires) and their associated impacts on drinking water quality, infrastructure, operations, and protection programs. Examples of events and impacts that occurred during this reporting period are provided, along with lessons learned. In addition, resources for addressing drinking water impacts due to climate-related events are included, along with next steps.

10.1 Impacts on Drinking Water due to Flooding

British Columbia experiences multiple flood events each year, ranging from coastal to riverine and urban flooding. The damage and cost of these events is significant, and can negatively affect infrastructure, water services, ecosystems, and public health.[3] Although the location and severity of flooding varies from year to year, the frequency of both moderate and major flood events is expected to increase due to climate change. This could include repeat flooding in certain locations, or more flood seasons with flooding occurring simultaneously in multiple communities.[4] Notable flooding events that occurred during this reporting period are listed in *Table 10.1* and are described in the case studies in this chapter.[5]

Table 10.1: Large BC Floods, 2017 to 2021

2017	Okanagan and Interior floods
2018	Grand Forks flood
2020	Cowichan, Sooke, Port Coquitlam, Cariboo, Chilcotin, Nazko, Nicola, Kootenays, Kelowna, Vernon, Shuswap, McBride floods
2021	Atmospheric river flooding across southern and south-central BC (Nooksack River, Abbotsford, Merritt, Princeton, Coquihalla Highway, Highway 8, Highway 1)

Source: BC Ministry of Forests, Emergency Management BC. From Flood Risk to Resilience in B.C.: Intentions Paper Summary; 2022.[5]

Flooding due to changes in precipitation patterns will impact water quality and quantity, and disrupt both natural water systems (rivers, lakes, oceans) and human drinking water and wastewater systems, which will lead to increased health risks.[6] In BC, precipitation has increased across all seasons, except in winter, where it has decreased. Less precipitation is falling as snow, which has important implications on the volume and timing of river flow (i.e., the amount of available water that is discharged to rivers is decreasing, and the spring freshet is peaking earlier in the season). Certain climate models predict that annual precipitation will increase by 5.7 per cent by 2050 and 13.8 per cent by 2100 relative to measured precipitation from 1986 to 2005.[7] Extreme precipitation events may become more frequent and intense, and there could be an increased frequency of atmospheric river events.[a] These events will exacerbate the impacts associated with changes in seasonal precipitation, for example, by contributing to faster runoff, which will lead to an increased risk of flooding, landslides, and sediment and pollutant loading in drinking water reservoirs and aquatic ecosystems.[3] The extent and intensity of these changes will vary by region and season. While average annual precipitation is expected to increase, climate models predict there will be less summertime precipitation; this will result in an increase in dry periods, which will exacerbate existing regional droughts and lead to new droughts.

Drinking water systems and their users can also be impacted by flooding through:

- Stress or damage to drinking water sources due to inundation, debris, and water and soil contamination.
- Damage to water infrastructure, such as intakes, wells, pipes, and treatment facilities.
- Stormwater and wastewater failures, which could result in the uncontrolled discharge of untreated and/or contaminated wastewater or stormwater, which may lead to contamination of groundwater or surface water.
- Significant disruptions to, and delays in, the movement of goods and services required by water treatment facilities.
- Increases in waterborne diseases (e.g., cryptosporidiosis, giardiasis, campylobacteriosis).
- Disruptions to water and other infrastructure services.
- Threats to irrigation supplies, which could lead to the loss of agricultural crops and/or livestock.
- Mental health impacts due to concerns about water and food insecurity, evacuation, and disruption of lives.

10.1.1 Atmospheric River Event (2021)

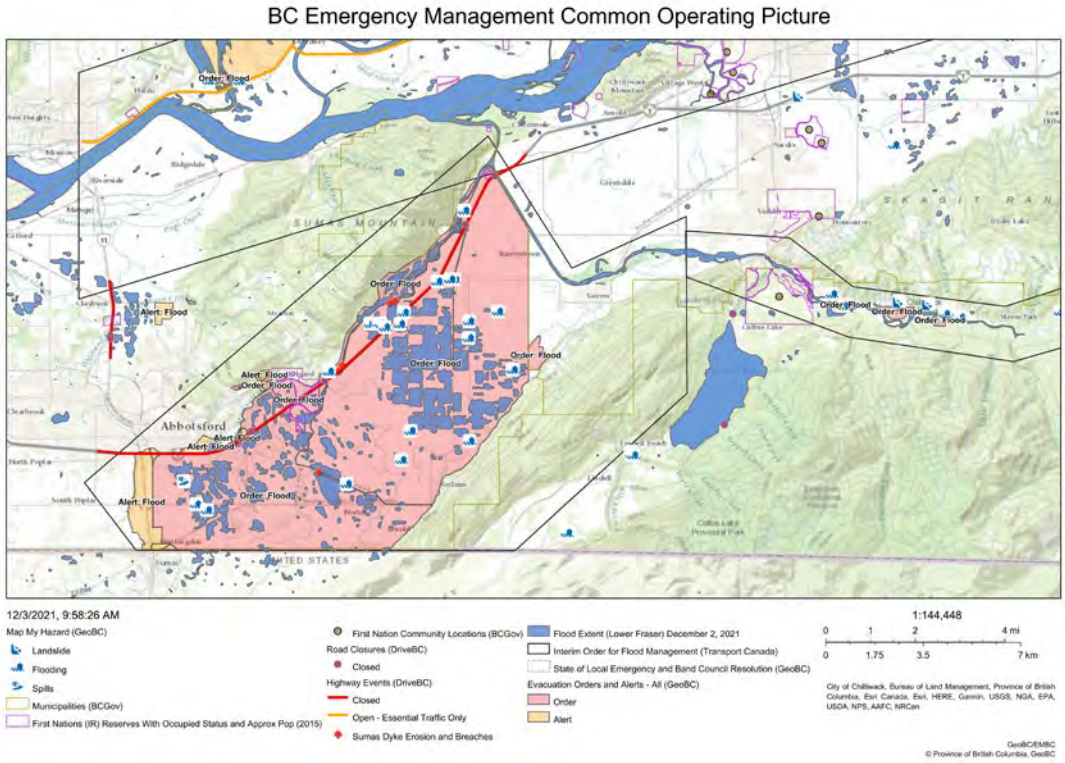
During this reporting period, many parts of BC experienced unprecedented flooding. In November 2021, parts of BC received more rain than ever previously recorded, with flooding brought on by three atmospheric river weather events. Major damage to drinking water and wastewater infrastructure occurred, which resulted in a temporary loss of clean, safe, and reliable drinking water in many affected communities, including several First Nations. Highway infrastructure was impacted by flood waters and slides, which severed all access routes to the Lower Mainland and several other areas of the province. This breakdown in transportation networks disrupted supply chain routes for essential drinking water supplies and routine water sampling shipments.[8] The following sections outline four flood case studies (Sumas Prairie, Merritt, Princeton, and Gladwin) that highlight the impacts that occurred to drinking water supply systems, the people who operate them, and the people who rely on them for drinking water. The response to, and lessons learned from, the disruptions of routine water quality sampling are also presented.

[a] An atmospheric river is a region of warm, moisture-laden air that is relatively long and narrow (but can span hundreds of kilometres in length and width) and borders a large cyclonic low-pressure system.

Sumas Prairie – City of Abbotsford

In November 2021, more than 500 mm of precipitation fell in the traditional territory of the Stó:lō Nation in the Fraser valley, which caused the local rivers to overflow. The Nooksack River in Washington State flooded into the Sumas River and toward a dike at the Fraser River, which resulted in extreme flooding of Sumas Prairie and the City of Abbotsford. Several sections of dikes failed, which resulted in the evacuation of 1,100 properties, Sumas First Nation reserve lands, and more than 3,300 people (*Figure 10.1*). Many farming and dairy operations were flooded; this resulted in a significant loss of crops and livestock, and raised concerns about uncontrolled releases of manure and other contaminants into the environment, which could reach sources of drinking water. Flooding also forced the closure of Highway 1 and the Sumas border crossing, which impacted cross-border traffic and trade.[9] This event and resulting dike failures also led to the widespread failure of transportation systems throughout southwestern BC, severed connections between communities, and cut off the municipalities of Chilliwack and Hope and several Indigenous communities in the Lower Mainland from the rest of the country.[10,11]

Figure 10.1: Evacuation Order and Alert Areas in Sumas Prairie during the 2021 Atmospheric River



Source: Data from Emergency Management BC – GeoBC; custom map prepared using Common Operating Picture web-based mapping tool; prepared by BC Office of the Provincial Health Officer, 2021 Dec 03.

(Top) Flooding in Abbotsford—Sumas Prairie, 2021. (Left) Discharge hosing connected to pumps to draw flood water from the Sumas Canal over the dike at the Barrowtown pump station and into the Fraser River, 2021.

Photo credits: City of Abbotsford.

The Abbotsford/Mission Water & Sewer Commission operates a regional water system that supplies bulk drinking water to approximately 160,000 people living in the City of Abbotsford and the City of Mission.[12] Each municipality operates its own distribution water system independently from the regional system and has individual operating permits issued by the Fraser Health Authority. Sumas Prairie is supplied by the distribution water system operated by the City of Abbotsford. Flooding of Sumas Prairie led to several water main breaks and damage to the intake of the main water source for Abbotsford's system. Although there was no evidence of floodwater contamination, the City isolated the flooded areas of the distribution system, and on November 18, issued a boil water notice for the affected area as a precaution.[13] On November 24, the City issued a do not consume notice as a precaution because it could not guarantee the ability to maintain positive pressure throughout the whole system while the distribution system and line breaks were being restored. Sumas Prairie remained under an evacuation order during this time.[14]

As a result of the damaged intake, Abbotsford had to rely on its smaller secondary water source to supply drinking water to the region, which has backup capacity for only a limited period. The intake was repaired before any major disruptions to water availability occurred, but the event highlighted a vulnerability in the system.[15]

On December 20, 2021, both advisories for Sumas Prairie were rescinded once enhanced disinfection and flushing of the system had been completed and biological and chemical water quality tests had confirmed that the requirements of the *Drinking Water Protection Act* (DWPA) and the *Guidelines for Canadian Drinking Water Quality* had been met.[13]

Since the 2021 flood, the City of Abbotsford has received Disaster Financial Assistance and funding from the Ministry of Municipal Affairs (MUNI) for several flood recovery projects and repair projects for critical infrastructure. For example, MUNI has provided $61.9 million (a portion of the total project cost) to the City to establish an additional groundwater source and related treatment system to ensure that residents receive drinking water from a more resilient water system in the face of growing climate-related threats.[9] Work on these projects is underway. Updates on long-term flood mitigation plans and flood recovery efforts are provided on the City of Abbotsford's website.[b]

In the aftermath of the flood, damages to the distribution system became visible in Sumas Prairie. (Left) A broken six-inch water main in Sumas Prairie after the flood. (Right) City of Abbotsford staff worked to assess the damages and estimate the replacement work needed for the water system within the isolated zone of the distribution network.

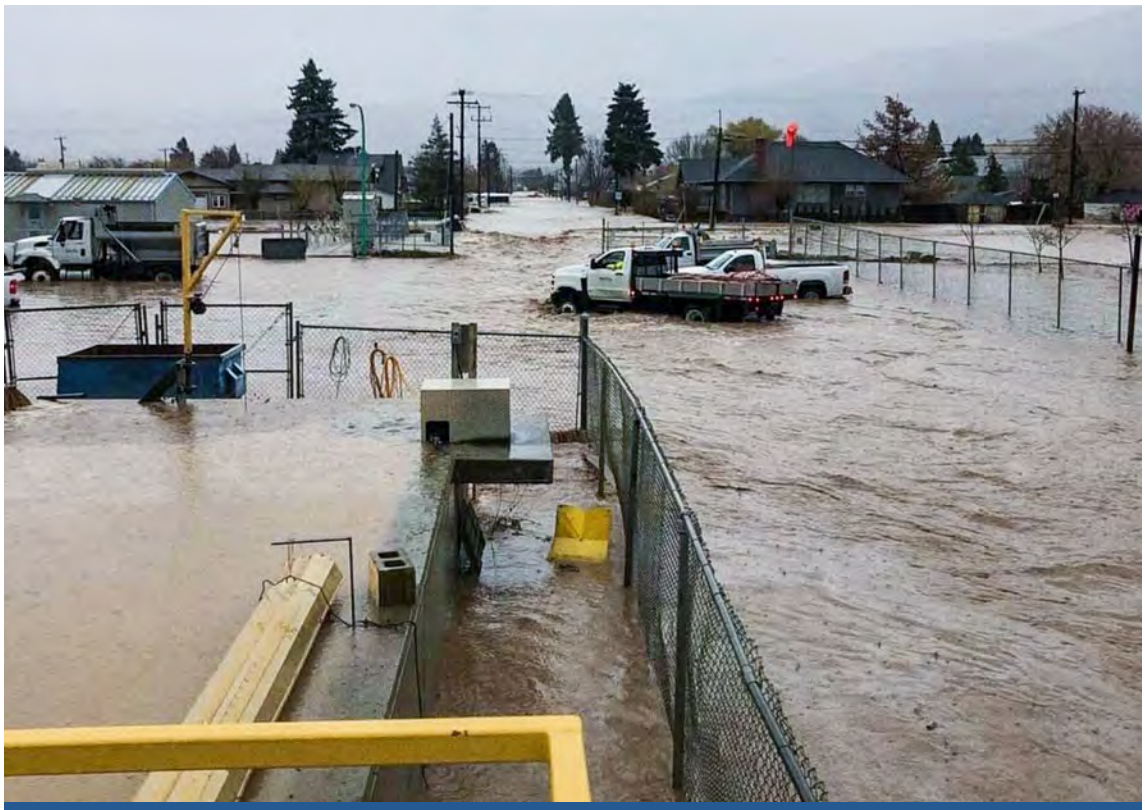
Photo credits: City of Abbotsford.

[b] *https://www.abbotsford.ca/floodresponse*

Merritt

The City of Merritt, located on the traditional territory of the Nlaka'pamux Nation Tribal Council and Syilx Okanagan Nation within the Nicola valley and in the Interior Health region, lies within the 200-year floodplain of the Nicola River and Coldwater River watersheds. Merritt was also impacted by three successive atmospheric river events in November 2021, which resulted in widespread flooding. The excessive rainfall coupled with warming temperatures resulted in increased snowmelt and a rain-on-snow runoff event, which led to a rapid and significant rise of the Coldwater River. As a result, the river breached its banks and dikes overflowed, which resulted in flooding of parts of the community.[16] Floodwaters overwhelmed the community wastewater treatment plant's rapid infiltration basins, which damaged them and removed them from service. However, the treatment plant itself was undamaged, which allowed the City to partially treat wastewater and discharge it to the Coldwater River based on approval from the Ministry of Environment and Climate Change Strategy (ENV) through a special amended permit. Authorities considered the public health risk from the emergency discharges to be low because the river provided a high dilution factor, the wastewater was partially treated, and no downstream domestic water systems or private intakes were identified. However, this scenario should be used in planning, particularly in places where there is a drinking water intake downstream of a wastewater discharge site.[17,18]

A state of local emergency was declared for Merritt, and the entire community of 7,100 residents was evacuated. The impact of city-wide closures and damage to critical infrastructure (the wastewater treatment plant, the drinking water delivery system, dikes, and transportation networks and bridges) resulted in the complete shutdown of schools, and health care and essential emergency services. Residents had no access to potable water or sanitary services. The atmospheric river events crippled the transportation infrastructure of Merritt and many surrounding communities,



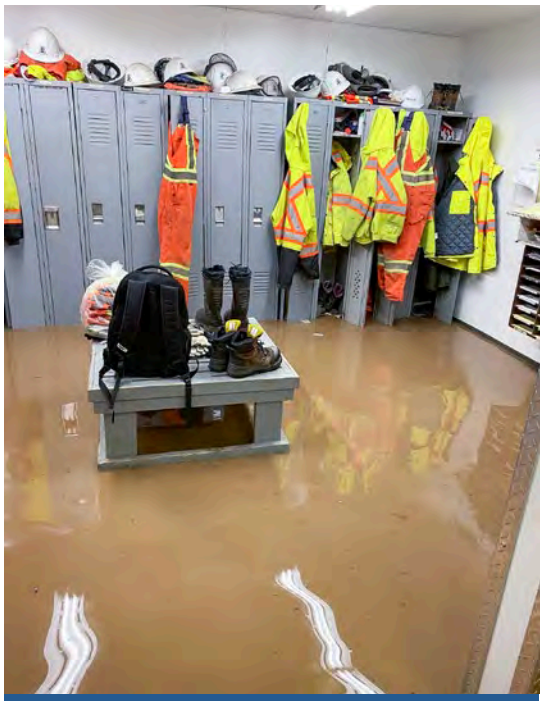
Flooding of the Merritt wastewater treatment plant, November 2021.

Photo credit: Kevin Vilac, CWP CWWP, Chief Operator of the Water and Wastewater Systems, City of Merritt, BC. Environmental Operators Certification Program Operator Digest—Spring 2022/Number 152. Reproduced with permission.

which significantly impacted access to some areas.[18] Damage to commercial, residential, and municipal property was extensive.[16]

The damage to Merritt's drinking water system was significant, and included a major break in the distribution system that led to the loss of all water from one of the City's reservoirs.[19] Merritt also temporarily lost two of its five groundwater wells that provide the city with drinking water. According to City reports, both damaged wells were contaminated with flood water, silt, and debris. Although the piping system within both wells remained intact, the control system for the wells was damaged (i.e., one lost a flow meter; the other lost its housing structure, monitoring equipment, and pump drive).[20] Both wells have since been repaired.

Given the immediate threat to drinking water from this emergency, a do not use notice was issued for the city. Following distribution line repairs, flushing, and testing of the system, the advisories were eventually downgraded to a do not consume notice and a boil water notice (*Table 10.2*). All advisories for the water system were lifted after 22 days.



Flood water inside Merritt's public works building, November 2021.

Photo credit: Tom Harrington, CWP CWWP, Utilities Supervisor, City of Merritt, BC. Environmental Operators Certification Program. Operator Digest—Spring 2022/Number 152. Reproduced with permission.

Table 10.2: City of Merritt: Timelines of Drinking Water Advisories as a Result of the 2021 Atmospheric River Floods

Timelines of Advisories	Type of Advisory	Reasons for Advisory
November 16-22, 2021	Do not use notice	On November 16, a do not use notice was issued for Merritt. It aligned with emergency notifications issued by the City the previous evening for infrastructure failures, including the loss of pressure in the drinking water distribution system and the failure of the sewerage plant.
November 22-December 3, 2021	Do not consume notice (lower distribution zone of the city) and boil water notice (upper distribution zones of the city)	Following an initial site and system assessment, the upper zones were downgraded to a boil water notice. The lower zone, which had suffered significant distribution line damage, was downgraded to a do not consume notice.
December 3-9, 2021	Boil water notice	The lower zone do not consume notice was downgraded to a boil water notice following distribution system repairs. The City lifted the boil water notice for the entire community following flushing and testing of the distribution system.

Source: Interior Health; 2023.[21]

The scale of the damage to Merritt's critical infrastructure for drinking water and wastewater was significant and exceeded the system operators' capacity to manage it on their own. As a result, several neighbouring municipalities and water supply system operators came to Merritt's aid. According to the Environmental Operators Certification Program (EOCP), the City of Kelowna, City of Kamloops, Black Mountain Irrigation District, Logan Lake, and CGL Contracting

supported Merritt by providing works crews, equipment, and supplies. The EOCP described in detail how the crews worked in tandem alongside Merritt's operators to repair the systems and get them back online as quickly as possible.[19] Lessons learned from the coordinated response included the following:

- Accurate and up-to-date mapping of critical infrastructure is essential.
- Planning for major disasters and widespread infrastructure failures is needed.
- Identification of a response team, clarity on roles and responsibilities, and good communication are needed.
- Mutual aid frameworks or support between neighbouring communities can improve response capacity.
- Having safety equipment on hand and training is necessary.
- Valves and hydrants need regular testing and maintenance, and should be strategically located away from bridge or water crossings.[19]

Interior Health conducted a resiliency case study after the flood and found several factors that contributed to the relatively quick recovery of Merritt's drinking water system. Merritt's water system included two barriers of treatment that supplied high-quality drinking water that met provincial treatment objectives prior to the flood. In 2017, the City completed a source water assessment, which indicated that four of five of its production wells were located in a floodplain. Subsequent actions to mitigate the associated risk included raising the level of the wellheads above the level of potential floods and defining the well capture zones in order to implement well protection zones. The production well outside the floodplain that drew water from an unaffected aquifer added to the water system's resiliency because it provided an alternative water source during the flood. In addition, the City had made a commitment to having well-trained and prepared staff, providing appropriate monitoring and ongoing maintenance, and having an appropriate asset management plan and water master plan in place. The City had also completed an emergency response plan for flooding and power, and maintained strong communication during disaster response efforts. Pre-arranged resource-sharing agreements with neighbouring communities in the event of an emergency also contributed to a more efficient emergency response.[22]

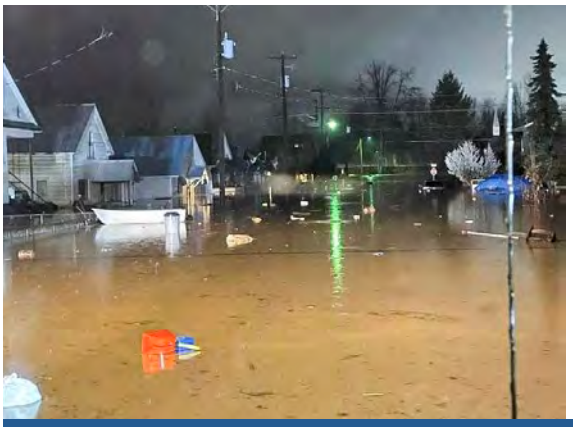
In 2022, a year after the floods, the City reported at least 5 per cent of residents were still displaced because major repairs were still ongoing. The City received $24 million in interim flood support funding.[23] A list of current and completed repair projects is provided on the City's webpage.[20,c] Although financial supports were made available, the City faced challenges accessing provincial and federal recovery funding.[22]

Princeton

The Town of Princeton and surrounding areas are located along the Highway 3 corridor, approximately 280 km east of Vancouver in the dry Okanagan Mountain range just east of the Cascade Range, and within the traditional territories of the Okanagan Indian Band and Nlaka'pamux Nation Tribal Council. Princeton is located at the confluence of the Similkameen River and Tulameen River, and is the largest community in the area, with a population of approximately 3,000 people.[24] On November 14, 2021, the Town declared a state of local emergency when heavy rains that month caused the Tulameen and Similkameen Rivers to overflow their banks and dikes, which inundated low-lying areas of downtown Princeton and Allison Flats with flood water and debris. Initially, 571 residents and 290 households were displaced.[25]

The Town of Princeton operates a community water supply system that consists of two distribution systems (an upper zone and a lower zone) and has three groundwater wells as its source supply. Surrounding areas are served primarily by private groundwater wells or small water systems. The town suffered significant damage to critical infrastructure and notable impacts on its water supply and wastewater facilities. Impacts that affected the water system included the failure of the sewer lift station, flood damage to the public works building, flooding of two of the pumphouses, and significant damage to the distribution system, which created the greatest impacts in the lower zone. Five river watermain crossings were also damaged, which raised concerns about water quality due to the backup of the sewer into the collection system. These damages contributed to the temporary shutdown of part of the

[c] *https://www.merritt.ca/flood/*



Rising flood waters inundate low-lying areas of the Town of Princeton, November 2021.
Photo credits: Morgan Grigg, CWP CWWP, Chief Water/Wastewater Operator, Town of Princeton, BC.

Town's distribution system.[24] As a result, drinking water advisories were issued for both the lower and upper zones of the distribution system (*Table 10.3*).[21]

The do not consume notice for the lower zone was necessary because there was a leak that crews were initially unable to find, which resulted in difficulty in maintaining water in the reservoir. Emergency crews were able to locate three water lines that passed under the river, which were then used to charge the distribution system for the lower part of the community. To resolve the leak, drilling under the river was required. Until that work could occur, crews implemented a temporary solution to increase the water pressure by running a fire hose over a bridge.[18]

The flooding also left the community and surrounding First Nations (e.g., the Upper Similkameen Indian Band and the Lower Similkameen Indian Band) temporarily vulnerable because access to health care services was disrupted. Damage to the water supply system resulted in a temporary closure of the Princeton hospital. Although the Emergency Room was able to remain open, there was no admission to the hospital because it was located in the red zone, where water had been shut off because the pumps were overheating. Patients were triaged at the Emergency Room and then transported to another site if needed.[18]

Water sampling of the Town's wells following the flood revealed the presence of turbidity, total coliform, and *E. coli*, all in excess of drinking water quality guidelines. At the time of writing this report, a boil water notice was still in effect for the lower zone of Princeton while the Town completes improvements, including the replacement of its wells.[24] In 2022, the Town received $11.9 million in support funding, $4.6 million of which is intended for improvements to the drinking water delivery system, including work to make the community wells, water distribution system, and water treatment system more resilient.[23]

Table 10.3: City of Princeton: Timelines of Drinking Water Advisories as a Result of the 2021 Atmospheric River Floods

Timelines of Advisories	Type of Advisory	Reasons for Advisory
November 15-17, 2021	Boil water notice	The flood affected community wells.
November 17-December 23, 2021	Do not consume notice (lower zone) and boil water notice (upper zone)	The boil water notice in the lower zone was upgraded to a do not consume notice due to significant leaks and resulting pressure loss.
December 23, 2021 to present	Boil water notice (lower zone)	After flushing and testing of the water system, the boil water notice was lifted for the upper zone. The do not consume notice was reduced to a boil water notice for the lower zone. Maintaining the advisory was necessary because assessments of the lower zone indicated the need for improvements to address an ongoing pathogen risk to well sources.

Source: Interior Health; 2023.[21]

Small Water Systems and 2021 Floods: Gladwin, BC

Small water systems tend to be more vulnerable and less resilient to climate change impacts than are larger local government water systems. The treatment systems of small water systems tend to be less robust in handling changes in water quality, and the integrity of the infrastructure often does not meet current standards. Access to trained personnel who can respond to flooding events, and access to funding and emergency supports are also limited. As a result, small water systems are at risk of falling into a state of further disrepair during climate-related events, as occurred in Gladwin, BC.

Due to the atmospheric river events, two small privately owned water systems with operating permits from Interior Health (the Gladwin Mobile Home Park and the Lower Gladwin Community Water System), located beside the Thompson River east of Lytton and within the traditional territory of the Lytton First Nation, were damaged by a debris flow. The slide destroyed their intake works, buried a storage tank, and severely damaged and swept away distribution lines.[26]

According to Interior Health, the water system for Gladwin Mobile Home Park serves approximately 32 people. The Lower Gladwin community water system serves five homes and approximately 18 people. Both systems draw water from 5½ Mile Creek and have been on a standing boil water notice for more than 20 years because they supply untreated surface water. After the flooding and associated debris flows, access to Gladwin was limited because highways were damaged. The mobile home park owners informed Interior Health that they had set up an emergency source of water and the Lower Gladwin water system had temporarily connected to their system. The emergency setup consisted of an aboveground storage tank and a series of overland pipes. Both water systems lost pressure (some units had no water at all), which increased the risk that contaminants may have been introduced into the systems; thus, the existing boil water notice was elevated to a do not consume notice for both water systems.

Despite the tenuous drinking water situation in Gladwin, the Thompson-Nicola Regional District determined that evacuation of the mobile home park and the residents of lower Gladwin was not necessary, and it did not provide emergency support to those water systems.[27] More than a year later, Interior Health confirmed through site visits that both water systems remained

Overland piping and emergency storage tank at Gladwin after damages from debris flow.

Photo credit: S. Wong, Environmental Public Health, Interior Health, December 2022.

vulnerable to poor water quality, further infrastructure damage, and loss of supply. In addition to the failing distribution systems, inadequate intake structure, and substandard storage, both systems continue to provide no water treatment. It is also unknown if the creek that supplies both systems will be able to sustain them going forward.[28]

Neither small water system is owned or operated by a local government; therefore, their funding options are limited because only local government water systems are eligible for infrastructure grants from the Province. Disaster Financial Assistance may be available under certain circumstances; however, the funding has a deductible and only 80 per cent of the eligible amount is provided, which may challenge the small water systems that serve Gladwin to come up with the necessary remaining funds, given the extent of the damages incurred.[27]

10.1.2 2021 Floods: Provincial Response – Water Quality

Flood Water Quality Monitoring Task Force

In response to concerns about water quality as a result of the November 2021 floods, a multi-agency provincial task force was formed to assess risks and inform provincial and local agency decision makers about those risks. The task force included representatives from the First Nations Health Authority (FNHA), the Ministry of Indigenous Relations and Reconciliation, and members of local First Nations. The task force assessed initial water quality and potential risks from contaminants due to the floods, developed conceptual site models, and completed human health and ecological risk assessments for the flood-impacted areas of Sumas Prairie, Merritt, and Princeton. The assessments were conducted to determine the risk of, and exposure to, potential contaminants, and to inform long-term monitoring requirements and other government actions, if required.[29] The results of the assessments and the work completed by the task force are available at the Flood Water Quality Monitoring Task Force Hub.[d]

The risk assessments were conducted because of concerns that flooding due to the atmospheric river events could have spread contamination from agricultural and industrial operations, and on-site septic and/or municipal sewage systems. *Table 10.4* lists these potential sources of contamination, in addition to several other common and area-specific potential sources that were determined through the development of conceptual site models.

The risk assessments indicated that a number of contaminants were detected in similar materials across all three study areas. In the Sumas Prairie and Merritt areas, total coliform, fecal coliform, and *E. coli* were found in the soil and sediment, whereas only total coliform and fecal coliform were present in the soil and sediment in the Princeton area. Total coliform and *E. coli*

Table 10.4: Potential Sources of Drinking Water Contamination for Sumas Prairie, Merritt, and Princeton, BC

	Sumas Prairie (Stó:lō Nation territories)	Merritt (Nlaka'pamux Nation Tribal Council and Sylix Okanagan Nation territories)	Princeton (Nlaka'pamux Nation Tribal Council and Okanagan Indian Band territories)
Potential contaminant sources	• Upgradient runoff from Washington State (e.g., manure pits, pesticide and fertilizer storage, fuel tanks) • Naturally occurring asbestos in sediment deposits from the Nooksack River • Locally contained contaminants (e.g., fuel storage tanks, automotive parts, manure pits, septic systems, highway runoff)	• Wastewater treatment plant, sanitary sewer system, and rapid infiltration basins • Environmental remediation sites (e.g., fuel station, sawmills, biomass refinery) • Runoff from agricultural areas • Septic systems and septic fields	• Sewer system (including lift stations and force main) • Environmental remediation sites (e.g., fuel station, salt storage site, coal mines) • Fuel sources (e.g., storage tanks, oil tanks, vehicles) • Runoff from agricultural areas

Source: BC Ministry of Environment and Climate Change Strategy. BC Flood Water Quality Monitoring Task Force Hub; 2022.[29]

[d] *https://fwqmtf-bcgov03.hub.arcgis.com*

were found in groundwater samples from the Merritt and Princeton areas. A surface water quality survey was conducted in the three areas. Samples were analyzed for parameters such as pesticides and fertilizers, hydrocarbons, and septic system indicators, but their concentrations in surface water were not different from those measured during pre-flood conditions.[30,17,24]

Potential contaminants were also assessed in the three study areas. The Sumas Prairie tests included the largest number of individual parameters tested for, owing to the large extent of flooding that had occurred. Additionally, surface water on the Sumas River and its tributaries, and in the Fraser River was sampled. This resulted in a larger data set for Sumas Prairie than for Merritt or Princeton because surface water samples could not be collected in those areas. The risk assessment for Sumas Prairie identified the presence of arsenic in the soil; however, it was determined to be within naturally occurring levels. The assessment also identified the presence of chromium, nickel, and phenanthrene in a small subset of the soil samples, and glyphosate in the sediment samples. Chromium and nickel can be harmful if consumed by animals; however, results from additional studies conducted in 2022 determined that the levels of those elements were safe for animals and plants.[31] The concentrations of phenanthrene in the soil and glyphosate in the sediment were determined to be within acceptable limits. Tests were conducted specifically for asbestos because it occurs naturally upgradient of the study area; however, the results of the soil sampling indicated that asbestos had not been spread by the flood.[30,17,24]

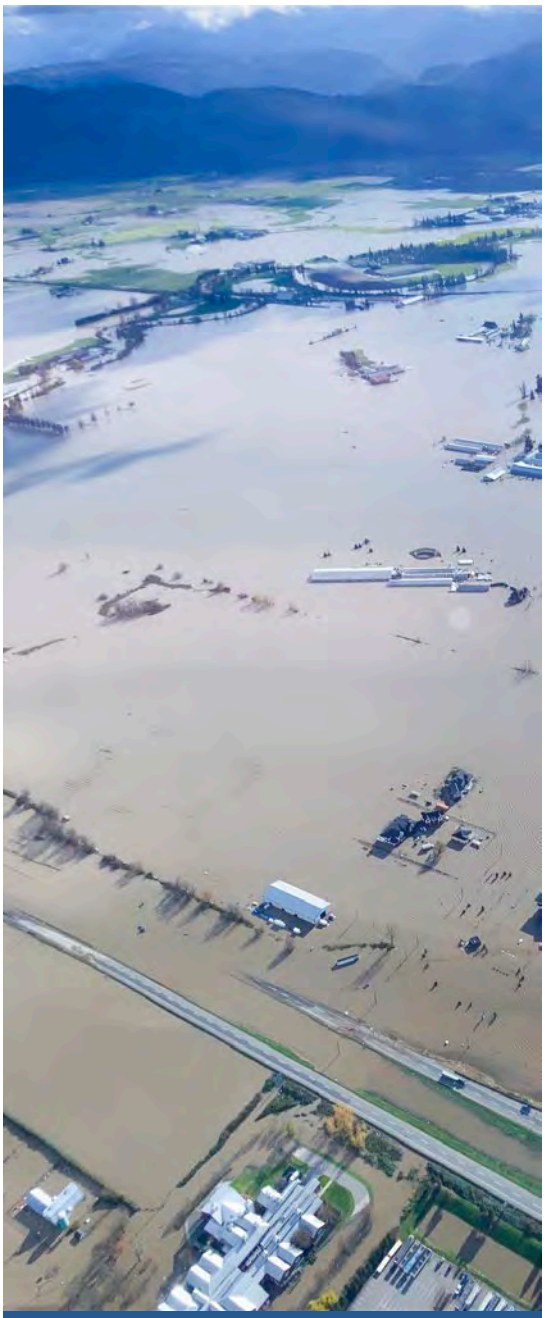
Emergency Application of Liquid Manure to the Land

The land application of liquid manure in high-precipitation areas during November, December, and January is currently prohibited under the Code of Practice for Agricultural Environmental Management because it can pose a high risk of contamination to surface water.[32] Manure contains contaminants of concern for human health, and after the flood, there were concerns about potential short-term and long-term impacts on drinking water if manure storage systems were to fail.

As a result of the November 2021 atmospheric river event, some dairy farmers in high-precipitation areas of Sumas Prairie needed to apply liquid manure to their land to prevent overflows or failures of their liquid manure storage systems. During the atmospheric river event, 322 premises were affected by excessive rainfall, which was collected by liquid manure storage systems. Additionally, approximately 135 farms throughout BC reported the need to dispose of milk into liquid manure storage systems due to disruptions in the supply chain and in transportation access. Many of these farms needed to take action to prevent the overflow or failure of their manure storage systems, which would have been a direct source of pollutants that could enter vulnerable water bodies. The storage structures could have become inoperable due to structural or pump failures, which would have affected the farmers' ability to store liquid manure. This could have led to worse impacts than applying liquid manure to the land in a controlled way on an emergency basis because there would be no ability to control the release of manure.

Farms were able to apply to ENV for authorization to discharge excess liquid manure onto their land. The applications were authorized under section 91.2(3) of the *Environmental Management Act* in order to mitigate the risk of a storage failure, which could have resulted in an uncontrolled discharge to the environment.[33]

Once ENV received an application, a technical review was conducted using maps of the locations under consideration and comparing them with locations of nearby aquifers, wells, and water sources. Farmers had to include the volume of material they wished to apply to the land. ENV then determined the volume of liquid manure (if any) that was allowed to be applied, and where it could be applied. ENV developed a communication strategy in coordination with industry associations, the Ministry of Agriculture and Food, Ministry of Health (HLTH), Provincial Health Officer (PHO), and Fraser Health Authority through the provincial emergency coordination centre to inform farmers of the requirements for the land application of manure. The communication strategy included informing Fraser Health, the FNHA, and local First Nations of all requests for emergency applications of liquid manure.[34] By the end of the limited approval period (December 9 to 19, 2021), 81 orders for the application of liquid manure to the land were issued.



Flooded farms on Sumas Prairie.
Photo credit: City of Abbotsford.

Private Well Water Sampling Program

Within the areas affected by flooding due to the atmospheric river, many privately owned and operated drinking water wells may have become contaminated or damaged, which would have resulted in unsafe drinking water. Whereas small and medium-sized water systems regulated under the DWPA receive subsidized bacteriological sampling, private water systems do not. As a result, HLTH, the regional health authorities, and the BC Centre for Disease Control Public Health Laboratory (BCCDC PHL) developed a short-term microbiological sampling initiative to help private well owners in areas affected by flooding and the emergency land application of liquid manure obtain information about the state of their wells.

The program was designed to help private well owners obtain sampling materials and instruct them on how to collect water samples, determine a pickup and drop-off point to facilitate sending samples to an approved laboratory, and obtain free analysis of the samples and interpretation of the results. Sample analysis was limited to microbiological testing; no chemical testing was offered. Well owners were offered repeat testing if *E. coli* was detected, until it was no longer detected. BCCDC PHL has offered private wells free water sampling in the past in response to specific events, but never at this scale. As a result, planning and development of communication materials was needed across the agencies involved.[35]

In response to the sampling program, 247 sites submitted samples for testing, 265 samples were analyzed for microbiological parameters, and six (2 per cent) samples tested positive for *E. coli* (*Table 10.5*).[36] In the event that *E. coli* was detected, the testing laboratory attempted to contact the well owner directly to provide further instruction. If *E. coli* was not detected, reports of the test results were sent to the well owners by the testing laboratory or the local health authority.

Table 10.5: Summary of Private Well Sampling Data Provided as Part of the Flood Response to, and Recovery from, the November 2021 Floods in BC

Region that Provided Samples	Number of Wells Sampled (e.g., sample sites)	Total Number of Samples Submitted (including wasted samples)	Number of Sample Sites with a Positive *E. coli* Test	Number of Samples that Tested Positive for *E. coli*	Number of Wasted Samples	Comments
Fraser Valley (Fraser Health)	9 (4%)	14 (5%)	0	0	0	Tested at BC Centre for Disease Control Public Health Laboratory (BCCDC PHL)
Regional District of Okanagan-Similkameen (Interior Health – Princeton area)	220 (89%)	251 (95%)	Data not available	6 (2%)	6 (2%)	Tested at BCCDC PHL-contracted lab. Communities included Princeton, Eastgate, Tulameen, Coalmont
Thompson-Nicola Regional District (Interior Health – Areas around Merritt)	18 (7%)					Tested at BCCDC PHL-contracted lab. Communities included Merritt, Kingsvale
Total	**247**	**265**	**0**	**6**	**6**	

Source: BC Centre for Disease Control Public Health Laboratory; 2022.[36]

Further interpretation of the test results was provided by the health authority. Most wells sampled were within the Regional District of Okanagan-Similkameen, in the communities surrounding Princeton (*Table 10.5*). Health officials attributed this largely to the active involvement of regional district staff, who distributed sample bottles to the surrounding communities, picked them up, and returned them to drop-off locations. In contrast, uptake of the program in the Fraser Valley was low. Because most residents in Sumas Prairie are served by the City of Abbotsford's water system, it is not known if the low uptake in the Fraser Valley was due to a lack of private wells being impacted or if the information about the program had not reached the intended population.

In February 2022, after the conclusion of the private well water sampling program, the PHO surveyed the BCCDC PHL, Interior Health, Fraser Health, and HLTH to identify lessons learned.

Respondents had consensus that such a service should be offered in future climate-related emergencies, but with the following provisos:

- Clearly define the scope, purpose, and eligibility of the program;
- Develop the needed guidance documents, education materials, and sampling forms ahead of time;
- Develop transportation plans to ensure samples reach testing laboratories within the required time frame;
- Establish communication protocols and know what needs to be communicated to whom and how;
- Explore opportunities to coordinate and manage the program in partnership with emergency response centres and local governments; and
- Provide a budget to cover testing, logistical costs, and staffing.[37]

Point-of-Use Testing

As outlined in Chapter 6, the BCCDC PHL routinely provides small and medium-sized drinking water systems in BC with subsidized bacteriological water quality testing. During recent climate emergencies, including the floods associated with the 2021 atmospheric river event, the BCCDC PHL had to act quickly to sustain access to the public health lab and sub-contracted labs when transportation networks were severely impacted so that water samples could be tested within the 30-hour time limit needed to obtain credible bacteriological test results. Courier shipments of routine drinking water samples to the BCCDC PHL or sub-contracted labs relies on a combination of ground transport and flights. All ground courier routes through the Lower Mainland were impacted due to widespread road closures (*Table 10.6*); therefore, samples from some areas could not be shipped to the labs. Flight limitations due to the pandemic compounded the issue.[38]

In response to the disruptions caused by the 2021 floods, the BCCDC PHL exhausted all opportunities for transporting samples by air to the public health lab for testing, and where air transport was not feasible, diverted samples to sub-contracted labs in Kelowna and Prince George. The City of Chilliwack and the District of Hope, and their surrounding communities, were completely inaccessible by road for several weeks after the atmospheric river event, which created considerable challenges in continuing routine water sampling. With the support of Fraser Health, the PHO, and the District of Hope, the BCCDC PHL purchased and deployed point-of-use testing (POUT) to the District of Hope to enable it to conduct water testing for the District and the surrounding communities in the Fraser Canyon. The following are lessons learned:

- POUT requires much support and multi-level coordination between all parties to start up.
- Obtaining human resources from all parties and allocating staff to perform the work was challenging amid competing and emerging priorities.[35]

10.1.3 Previous Flood Events

Although the 2021 atmospheric river caused the most widespread flooding and costliest natural disaster in the province's history,[39] several other flooding events occurred during the reporting period that impacted communities and their water supplies (*Table 10.7*).

Table 10.6: Impacted Transportation Networks for Courier Shipments of Routine Water Samples

Highway 1 between Hope and Lytton	Highway 5 between Hope and Merritt
Highway 1 between Lytton and Spences Bridge	Highway 7 between Maple Ridge and Mission
Highway 3 between Hope and Manning Park	Highway 11 between Mission and Abbotsford
Highway 3 between Princeton and Keremeos	Highway 93 between Radium Hot Springs and the BC-Alberta border
Highway 3 near Fernie	Highway 99 between Pemberton and Lillooet

Source: BC Centre for Disease Control Public Health Laboratory; 2022.[38]

Table 10.7: Flooding Events in BC Prior to 2021

Grand Forks (2018) (Syilx Okanagan Nation traditional territory)	In 2018, intense rain, combined with snowmelt in the mountains, caused the Kettle and Granby Rivers to overflow their banks. The confluence of the Kettle and Granby Rivers exceeded a 200-year flood level, which led to the worst flooding in the Regional District of Kootenay Boundary — 60 cm higher than ever recorded. Across the region, homes, trailers, and farms were submerged in dark flood waters, which forced thousands of people from their homes, and required 30 rescue evacuations in the immediate aftermath. The City of Grand Forks experienced the worst flood in history, which lead to multiple residential, commercial, and industrial neighbourhood evacuations and 38 rescues by boat and helicopter.[40] According to Interior Health, the City did not issue any advisories during the 2018 floods. The City is serviced by five protected wells that receive secondary disinfection.[41]
Okanagan Lake (2017) (Syilx Okanagan Nation traditional territory)	The beginning of 2017 started with a colder and drier winter than usual. However, a wetter than usual spring and late snowfall led to saturated soils, slope instability, and landslides. The persistent rain accumulation and snowmelt caused rivers to overflow their banks and lake levels to rise. The Okanagan Lake area experienced some of the highest sustained lake levels in recorded history. Because the soils surrounding Okanagan Lake were saturated, lake water could not be absorbed, and high-water levels were exacerbated by a series of passing storms and wind events.[42] The Provincial Health Officer does not have any information on the impacts of the 2017 Okanagan Lake floods on water suppliers.

10.1.4 BC Flood Strategy and Intentions Paper

BC is defining a new strategic framework for flood management to increase flood resilience in the province (*Figure 10.2*). This will be informed in part by engagement with First Nations, whose needs, values, and worldviews will be incorporated into flood management and decision making. The Ministry of Forests has drafted an intentions paper with a strategic vision that aims to clearly define what needs to be achieved, and how this could be done over time, by incorporating information collected at multiple engagement events related to flood management, disaster risk management, climate change, and resource stewardship.[43]

In October 2022, the provincial government released the document, *From Flood Risk to Resilience in BC: Intentions Paper*; it is a proposed strategic framework that includes a vision, outcomes, and principles for flood resilience in BC, and highlights the need for collective leadership in innovative, holistic flood risk management to enhance BC's flood resilience. The framework is complemented by four strategic program areas and associated potential actions for future implementation. They are based directly on the United Nations Sendai Framework for Disaster Risk Reduction, and on core themes that have been identified through all engagements to date.[43] The program areas are:

1. Understanding disaster risk.
2. Strengthening disaster risk governance to manage disaster risk.
3. Investing in disaster risk reduction for resilience.
4. Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction.[43]

Figure 10.2: Vision for Improving Flood Resilience in BC

Source: BC Ministry of Forests, Emergency Management BC. From Flood Risk to Resilience in B.C.: Intentions Paper; 2022.[43]

10.2 Extreme Temperatures

Since the last reporting period, BC has experienced some of the hottest and driest summers on record. For example, record-breaking summer temperatures were set in western Canada in 2017, when the southern regions of BC's interior and east faced their driest summer since 1948, and Kelowna experienced its warmest and driest August on record.[44]

Toward the end of June 2021, a large high-pressure ridge, known as a heat dome, developed over western North America.[45] The resulting heat wave lasted nearly two weeks and shattered temperature records. For example, on June 28, the temperature in Victoria was almost 40°C, a record and 20°C above the seasonal average. On June 29, the temperature in Lytton reached a Canadian record high of 49.6°C, the highest temperature observed anywhere in the world north of 45° latitude (which led to the fire that destroyed the village; see Section 10.4.2). In addition to record-breaking daytime and nighttime temperatures, 619 heat-related deaths were recorded in BC between June 25 and July 1, 2021.[46]

Similarly, in 2022, a heat dome affected the western half of North America. While the heat was not as intense as in 2021, the heat dome lasted several weeks longer. From mid-August to mid-October, more than 500 maximum daily temperatures records were broken. BC had one of the hottest Augusts on record, and Lytton recorded a high of 39.6°C on September 2, the highest temperature ever recorded in BC during September.[47]

The annual mean temperature in BC is projected to increase by 1.9°C[e] for 2031–2050 based on a high-emission scenario,[f] and by 5.2°C for 2081–2100 compared with the baseline for 1986–2005.[48] Extreme heat days (particularly those with temperatures above 32°C) are projected to become more common, and projections for 2050 show that an extreme heat wave could be expected to occur once every three to 10 years based on the same high-emission scenario.[49] Extreme heat events pose threats to water quality and water supply systems.

10.2.1 Impacts on Drinking Water due to Extreme Heat

Drinking water system operators need to be prepared to cope with the effects of extreme heat on source water quality and quantity, water treatment and distribution systems, and drinking water quality. For example, heat waves can cause increases in lake and river surface water temperatures, which can lead to an increase in harmful blooms of algae such as cyanobacteria.

Algae blooms usually form when there are increased nutrients, warmer temperatures, abundant light, and stable wind conditions. Some human-related impacts, such as agricultural runoff or improperly placed or poorly functioning septic systems, can also make blooms more likely. Cyanobacteria blooms (also known as blue green algae) are of particular concern because several species can produce toxins that can be harmful to humans, domestic animals, and livestock. Some toxins affect the nervous and respiratory systems; others affect the liver. Symptoms from drinking water that contains cyanobacterial toxins include headaches, nausea, fever, sore throat, dizziness, stomach cramps, diarrhea, abdominal pain, vomiting, muscle aches, mouth ulcers, and blistering of the lips. Sometimes, regional health authorities find it difficult to determine if an algal bloom is a risk to human health. Access to taxonomic analyses and identification of the algae would help regional health authorities make this determination.

In general, conventional water treatment (consisting of coagulation, sedimentation, filtration, and chlorination) can remove cyanobacterial cells and low levels of toxins. However, water systems may face challenges in providing safe drinking water during a severe bloom event when there are high levels of cyanobacteria and cyanotoxins in source waters.[50] Algae blooms can also block or interfere with the performance of water treatment equipment.

[e] Values provided are the median projection based on multiple climate models.

[f] Emission scenarios are based on a range of future emissions. A set of scenarios referred to as Representative Concentration Pathways (RCPs) are in common use to study future climate change. RCP8.5 is a high-emission scenario that was used in these temperature projections.

Algae bloom in St. Mary Lake, one of two water sources for the North Salt Spring Waterworks District, Saltspring Island, BC.

Photo credit: North Salt Spring Waterworks District.

Actions water system operators can take to manage algae blooms include:

- Moving a system's intake.
- Determining if the buildup of algae (a bloom) is cyanobacteria.
- Using an alternative water supply during cyanobacteria blooms.
- Testing to ensure the treatment system is removing toxins.

Compared to users of large municipal systems, users of small water systems that draw from affected surface water sources may be at greater risk of exposure to cyanotoxins because their systems likely have limited treatment capability.[51] *Table 10.8* (see next page) provides examples of water systems in BC that have been impacted by algae blooms.

Table 10.8: Examples of Water Systems Impacted by Algae Blooms

Regional Health Authority	Water System	Response
Island Health	Zuiderzee Campsites (Cedar/Yellow Point) Size: 15 connections Population served: Max. 40	The Zuiderzee Water System draws water from Quennell Lake. Elevated trihalomethanes and haloacetic acids have been detected in the system's water. Polyaluminium chloride flocculation and filtration are used to remove cyanobacteria cells, and granulated activated carbon is used to remove microcystins (the toxins produced by cyanobacteria) and other organics. The system is no longer able to remove sufficient organics, so it may not be removing microcystins. Testing for microcystin was done in 2020; raw and treated water were 10 times below the maximum acceptable concentration. An ongoing advisory to not use water in infant formula was listed in the system's annual report and was posted onsite.[52] To address the issue, the campsite drilled a new well in 2020. In July 2023, the campsite connected to the new well after undergoing a complete source assessment. Since only the new groundwater source supplies water to the system, there are no longer concerns about algal blooms impacting water quality.[53]
	North Salt Spring Waterworks District (Saltspring Island) Size: 950 connections Population served: Approx. 1,900	The North Salt Spring Waterworks District is an improvement district located on Saltspring Island, the largest of BC's southern Gulf Islands. The improvement district provides potable water from St. Mary Lake and Maxwell Lake to the village of Ganges and much of the north end of Saltspring Island. In 2016, St. Mary Lake supplied 58 per cent of the water distributed by the improvement district to more than 1,000 connections.[54] Water is withdrawn from the lake and is treated at the St. Mary Lake water treatment plant, which since 2019 includes dissolved air floatation (DAF). Water at the DAF plant is also treated with ultraviolet disinfection and chlorination. The turbidity and chlorine of the fully treated water are monitored continuously, and alarms are used to alert operators of problems if irregular results are found. St. Mary Lake is subject to frequent algal and cyanobacterial blooms and has had several toxic blooms in the past. There is ongoing testing of raw and treated water to monitor for toxins (most recently, from 2021). No advisories for this system were on record at the time of writing of this report.[52]
	Hague Lake Water System (Cortes Island) Size: 6 connections Population served: Max. 30	During the summer, the Hague Lake Water System, located on Cortes Island, draws water from Hague Lake (and Gunflint Lake, if interconnected), which are two small low- or no-flow lakes. The lakes are surrounded by many small properties that have septic systems (including small-scale farming and cattle operations). A review of septic filings of properties around Hague Lake indicated that a considerable proportion of properties had not completed an onsite sewerage system filing.[g] Currently, the water system is operating without a construction permit or an operating permit from Island Health. Algae blooms have occurred repeatedly on Hague Lake in the past, but there have been no clear signs of the presence of cyanobacteria. However, it is unclear if all issues have been reported to the health authority. The community has studied the issue and done testing in coordination with Ministry of Environmental and Climate Change Strategy staff. The community has also tried using its own mitigation measures, including using mushroom interceptor beds. Details of the system's existing drinking water treatment are not known. No advisories have been issued to date.[52]
Interior Health	Shuswap Lake Size: 1,356 connections Population served: Max. 14,671	The Shuswap Lake system experienced algae bloom events in 2010, 2020, and 2022 that significantly impacted communities aound the lake (e.g., Adams Lake Indian Band, Neskonlith Indian Band, Sicamous, Salmon Arm). The 2020 and 2022 blooms, which were dominated by cyanobacterial species occurred in the Salmon Arm portion of Shuswap Lake. The City of Salmon Arm and six small drinking water supply systems draw their drinking water from this part of the lake. During the blooms, all these systems had to redirect their resources toward increased monitoring and communication with users and the media. Following these events, emergency response and contingency plans were reviewed and adjusted based on the lessons learned and in anticipation of future algae blooms. All systems identified challenges with technology in providing ongoing testing (including from the intake), having clear triggers for action (e.g., issuing public advisories), and having administrative support (e.g., adequate funding, and proactive planning based on a changing climate). The small systems are working with drinking water officers to assess treatment works and options for avoiding future blooms, such as changing the source water and/or installing additional treatment barriers (e.g., filtration, enhanced oxidation). The City of Salmon Arm is participating in the Shuswap Watershed Council to coordinate sampling, public communications, and source water protection (e.g., reducing upstream sources of phosphorus to Shuswap Lake). The *Phosphorus Action Plan for the Shuswap Watershed*[h] provides guidance on actions everyone in the Shuswap watershed can take to protect water quality by reducing the amount of phosphorus being released into the watershed.[55]
	West Kelowna's Rose Valley Lake reservoir Size: 7,300 connections Population served: Max. 19,200	The Rose Valley Lake reservoir is an important multi-use natural asset that has served as a principal drinking water source for communities on the west side of Okanagan Lake for more than half a century. Issues with phosphorous loading and shallow, slow-flushing water have been ongoing for a long time, and efforts have been made to manage algae blooms directly in the reservoir and to reduce phosphorous loading from the inflowing Lambley Creek (see the *Lambley Creek Community Watershed Source Assessment Report*[i] for more information). Poor water quality in the reservoir has resulted in 24 advisories being issued for users in the past five years. The City of West Kelowna decided that improved treatment was needed. The City's $75 million Rose Valley Water Treatment Plant[j] project to improve treatment, including filtration, is near completion and will help the community manage future impacts from algae and climate change.[55]

[g] Prior to constructing a sewerage system, an authorized person must file information with the local health authority, including plans and specifications for the sewerage system, a property site plan, applicable covenants, easements or hydrogeological reports, information about the owner, authorized person, property location, site conditions, type of sewerage system being constructed, and type of structure the system will be serving.

[h] https://www.fraserbasin.bc.ca/Phosphorus_Action_Plan.html

[i] https://a100.gov.bc.ca/pub/acat/documents/r19919/LamblyCreekSourceAssessmentReport2_1285792136244_e0bd7e8bbf1803c8604e85502c8be38c9fd8648a0fa17eab4fafd53e92a49e90.pdf

[j] https://www.westkelownacity.ca/en/our-community/rose-valley-water-treatment-plant-project.aspx?_mid_=38297

In 2019, a new dissolved air floatation treatment plant came online for the North Salt Spring Waterworks District to improve water quality for the community.

Photo credit: North Salt Spring Waterworks District.

In Canada, cyanobacteria can occur in water bodies at any time of year, although rapid proliferation that causes blooms (known as cyanoblooms) occurs mostly in the summer.[56] However, the occurrence of harmful algae blooms is expected to increase across Canada due to warming temperatures and increased nutrient loads in source waters.[57]

Long periods of heat can also lead to low water levels and result in poor water quality as bodies of water become stagnant, pollutants concentrate, and pathogens proliferate, which can pose a risk to human health. Source water that has high pollutant and pathogen concentrations may require additional treatment, which can add to a community's cost of providing safe drinking water. Increased demand for water (e.g., for drinking, showering, plant watering, recreational purposes, and evaporative cooling units) during heat waves can also place stress on drinking water systems.[58] Prolonged periods of heat can also result in drought conditions and water scarcity (see Section 10.3).

The following case studies from the City of Salmon Arm, Resort Municipality of Whistler, and Greater Victoria illustrate some of the challenges drinking water systems can face due to extreme heat.

10.2.2 2021 Heat Dome

Salmon Arm

The 2021 heat dome and drought led to excessive water use throughout the City of Salmon Arm, located on the traditional territory of the Tk'emlúps te Secwépemc on Shuswap Lake in BC's interior. The maximum daily demand for water far exceeded any previous peak in demand and stressed the City's drinking water supply system.[59] The City was particularly concerned about its ability to keep the reservoirs filled with enough water to maintain flows needed for firefighting. As a result of this experience, the City included recommendations in its 2022 *Community Water Conservation Plan*[60] to reduce peak demand and help reduce the probability of a similar occurrence in the future. The recommendations included using measures such as:

- Universal water metering to help users become aware of how much water they use, and to provide usage information to city staff to help reduce peak consumption; and
- Multistage watering restrictions to reduce peak consumption and increase awareness about water conservation.[60]

The City instituted multistage watering restrictions in April 2023, but universal water metering is a long-term priority for 2028–2031.

Resort Municipality of Whistler

Due to the 2021 heat dome, the Resort Municipality of Whistler also experienced a very high water demand. Whistler is located on the traditional territories of the Líl̓wat Nation and Squamish Nation in the Coastal Mountains north of Vancouver.

The high temperatures also contributed to a large snowmelt event. As a result, Whistler's primary water source, 21 Mile Creek, had a nephelometric turbidity unit (NTU) that exceeded the limit of 1.0. During this type of event, Whistler normally draws from its groundwater wells until the NTU decreases below 1.0; however, during the heat wave, the daily water demand exceeded the wells' capacity for water extraction. As a result, stored water levels were compromised, including the availability of water for firefighting.[61]

To meet demand, Whistler used the 21 Mile Creek source while the NTU exceeded 1.0, in addition to the groundwater well system. With the approval of Vancouver Coastal Health, the resort municipality temporarily raised the NTU limit from 1.0 to 2.0 during this period.[61]

On June 27, a water quality advisory was communicated to the public, which stated that individuals with compromised immune systems should boil their water. The advisory was lifted on July 5, 2021 because the heat event had ended, and the water turbidity level had stabilized below 1.0 NTU.[62]

Capital Regional District – Greater Victoria Water Supply Area

During the heat dome in June 2021, reservoir levels in the Capital Regional District (CRD)[k,l] Greater Victoria Water Supply Area dropped below those recorded in previous years. Only in 2004, 2006, and 2009 was the summer water level in the Sooke Lake Reservoir lower than that in 2021.[63] Water use was so high that a key CRD storage balancing reservoir in North Saanich that services the Saanich Peninsula could not keep up with demand.[64] As a result, BC Ferries was asked to temporarily stop using drinking water from North Saanich to refill their vessels at the Schwartz Bay ferry terminal at night to enable water levels in the reservoir to recover.[65] The District of North Saanich also advised the community to conserve water.[64] According to staff at the District of North Saanich and the CRD, automatic estate irrigation systems, nurseries, and overwatering of non-native landscapes were likely responsible for the exceptionally high demand.[65] Additionally, the Peninsula and Area Agricultural Commission reported that local farmers used considerably more water for irrigation in 2021 than in previous years.[65] A few weeks later, during another heat wave, demand exceeded capacity in a water main that supplies drinking water to the City of Victoria and the District of Oak Bay, which resulted in a drop in water pressure.[64] The CRD did not implement measures to mitigate these events but will closely monitor water use during future heat waves.[64]

10.2.3 Provincial Tools for Monitoring and Managing Water Quality during Extreme Heat

ENV, HLTH, and the Ministry of Agriculture and Food have several resources to help communities plan for impacts on drinking water sources that may be worsened by extreme heat (e.g., algae blooms), including resources for monitoring, assessing, and managing risks, and preventing or reducing the amount of nutrients that can enter source water and contribute to poor source water quality and algae blooms (*Table 10.9*).

10.2.4 Impacts on Drinking Water due to Cold Temperatures

Cold temperatures can also affect drinking water sources, treatment, and distribution systems. For example, during cold temperatures, runoff of de-icing agents that melt ice and snow can increase the salinity of surface water and groundwater sources. Once a saline water layer forms at the bottom of a reservoir, it can affect water quality and ecology. Sudden temperature drops can cause destratification of lakes and reservoirs, which can lead to the mixing of nutrients (e.g., iron and manganese) and cause algae blooms. Ice can also block drinking water

[k] The CRD's Integrated Water Services Department manages the Sooke and Goldstream Water Supply Areas, which supplies treated drinking water to the Greater Victoria Water System, which contains eight indivaidual distribution systems.

[l] The CRD is located in the traditional territory of the Lək̓ʷəŋən (Songhees) and Xwsepsum (Esquimalt) Nations, the W̱SÁNEĆ Nations (W̱JOŁEŁP (Tsartlip), BOḴEĆEN (Pauquachin), SṮÁUTW̱ (Tsawout) W̱SIKEM (Tseycum)), Sc'ianew, T'Sou-ke, Pacheedaht, and MÁLEXEŁ (Malahat).

Table 10.9: Resources for Monitoring and Managing Water Quality Impacted by Extreme Heat

Resource	Description
Algae Watch	In May 2021, the Ministry of Environment and Climate Change Strategy launched the Algae Watch website,[m] which allows BC residents to learn about harmful and non-harmful algae blooms, and to post the location and extent of an algal bloom, and their photos, online.[66] Community-based monitoring programs and tools like Algae Watch have been developed to support community science and help assess the impacts of nutrients and harmful algae blooms (e.g., cyanobacteria) on drinking water and recreation water.[66]
Decision Protocol for Assessing and Managing Cyanobacterial Toxins in BC Drinking Water and Recreational Water	The *Decision Protocol for Assessing and Managing Cyanobacterial Toxins in BC Drinking Water and Recreation Water*[n] was first published in the *Drinking Water Officers' Guide* in 2017 and was revised in 2018. It provides strategies and resources to assist local governments, health authorities, and water system operators assess and manage risks related to cyanobacterial blooms in water bodies that are used for drinking water and recreational purposes. It includes strategies for engaging interested parties and choosing appropriate evaluation methods, and protocols and actions for reducing risks due to blooms.[56]
Nutrient Management Calculator	The Nutrient Management Calculator[o] helps producers in planning nutrient applications and managing nutrient sources, such as manure or compost. It also helps them determine the appropriate application rates for fertilizer and manure on farms so as to reduce the amount of nutrients, particularly nitrogen, that end up in water bodies.[67]
Nutrient Management Plan training	The Ministry of Agriculture and Food has developed resources and provides training to farmers and consultants to help them create nutrient management plans, which are required under the Code of Practice for Agricultural Environmental Management (AEM Code)[p] for farms that are in high-risk areas and meet certain conditions.[68] Nutrient management plans are used to help farmers meet their production objectives and protect the environment, particularly water quality.[67] The nutrient management plan course[q] focuses on applying nutrients in an efficient manner to produce crops and minimize the risk of nutrient input into water bodies.[69]
BC Application Risk Management Tool	On BC's south coast, farmers are not permitted to spread manure on their fields in November, December, and January. However, once they have completed a risk assessment (a requirement of the AEM Code), and the assessment shows a "low" risk rating, they can apply manure to their fields in October, February, and March. The Ministry of Agriculture and Food developed the BC Application Risk Management (ARM) Tool,[r] which has two components: an online interactive map that uses weather forecasts and farmers' field conditions, and a responsive smartform that allows farmers to see how changing conditions affect their overall risk rating and the risk of runoff of manure or other nutrients into water bodies.[67] The Ministry of Agriculture and Food performs outreach on the ARM Tool and the risk assessment portion of the AEM Code to ensure farmers are aware of their responsibilities regarding manure application, the ARM Tool, and the need to protect water quality.[67] The Ministry of Environment and Climate Change Strategy is responsible for ensuring compliance with, and enforcement of, the AEM Code.

system intakes, and cold weather can rupture pipes. Freeze–thaw cycles can weaken the integrity of underground pipes and cause water main breaks and water service disruptions.[70]

On December 18, 2022, the temperature in the City of Prince Rupert dropped to -13°C,[71,s] the coldest recorded on that day since 1908. Temperatures remained cold, and records were set for December 19 (-15°C) and December 20 and 21 (-16°C).[72] As a result of this cold snap, the city experienced water system service disruptions.

2022 Prince Rupert State of Local Emergency

On December 8, 2022, a water distribution main broke in the City of Prince Rupert, located on BC's northwest coast in the traditional territory of the Tsimshian First Nations. On December 15, two additional distribution mains failed. These breaks resulted in considerable damage to a city street, flooding of some residences, and a lack of water supply to other homes.[73] The disruption in service coupled with the potential for additional water main breaks due to freezing temperatures

[m] *https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/algae-watch*

[n] *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_b_-_8_cyanobacteria.pdf*

[o] *https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/soil-nutrients/nutrient-management/nutrient-management-calculator*

[p] *https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/8_2019*

[q] *https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/soil-nutrients/nutrient-management/nutrient-management-plans/nutrient-management-plan-training*

[r] *https://agri-nmp-msa.apps.silver.devops.gov.bc.ca/*

[s] The daily average temperature in Prince Rupert in December is 2.2°C; the daily average maximum temperature is 5.1°C, and the daily average minimum temperature is -0.8°C.

increased the potential that municipal crews would be overwhelmed in dealing with the response, which prompted the City to declare a state of local emergency on December 17, 2022.[74]

During this time, the water intake was operating at, or near, maximum capacity and was vulnerable to any changes in the system, including additional line breaks. The breaks also impacted the chlorination system, and city staff were unsure if they would be able to continue to deliver potable water.[73]

On December 19, the City advised that the state of local emergency was still in effect because there were three water main breaks and six water service breaks. Municipal crews repaired the distribution mains and hired specialists from Vancouver and Alberta to help.[75] On December 24, 2022, the City's Emergency Operations Centre lifted the state of local emergency.[76]

Although no water quality advisories were issued during this time, the City called a state of local emergency due to escalating water breaks in the community, which resulted in the short-term loss of water service to several households. The city council activated the Emergency Operations Centre in order to respond to a potential reduction of the community reservoir's capacity due to water main breaks within the system, and to bring in additional resources to respond to infrastructure needs.[76] In 2023, during the development of this report, the City received $65 million from the Province to support water distribution renewal work.[15]

10.3 Drought

Prolonged periods of heat can lead to drought. Drought is a recurrent feature of climate that involves a lack of precipitation over an extended period, and results in a water shortage. In BC, combinations of insufficient snow accumulation, hot and dry weather, or a delay in rainfall may cause drought. Drought conditions have occurred in BC and have impacted water systems and communities (*Table 10.10*). Drought conditions are anticipated to occur more frequently in BC due to climate change, especially in the interior regions of the province.[77]

10.3.1 Impacts on Drinking Water due to Drought

Drought can lead to reduced water availability for households and businesses. Drinking water systems and their users can be impacted through:

- Reduced water quantity and quality for basic household needs due to competing needs from industry and agriculture.[80]
- Lower water levels that could concentrate contaminants or pathogens in source water, which could increase the risk of contracting a waterborne illness from surface water.
- Contaminated source water which may require additional treatment to meet drinking water standards.
- Loss of water pressure and water supply (e.g., in situations where there is less available potable surface water, people may make heavier withdrawals from groundwater wells).

Table 10.10: Drought Conditions Experienced in BC, 2015 to 2022

Year	Drought Conditions
2015	The drought season began early when lower-than-normal snowpacks melted in the spring due to an early heat wave. Drought levels increased quickly due to hot, dry conditions across much of the southern half of the province and peaked in late August. Based on the historical record, this drought was considered to be severe.[78]
2017	Significant spring flooding delayed the start of the drought season. However, almost no rain fell in southern BC from the beginning of June to the end of October. As a result, 2017 was the driest period for 70 years.[78]
2021	Spring 2021 was extremely dry. Victoria Airport recorded just 53 mm of rain during spring, which broke an 80-year record. Dry, warm conditions continued through May, and at the end of June, the heat dome caused all-time maximum temperatures to be shattered. The drought intensified in August and September, and the Salmon River in the South Thompson basin, the Kettle basin, and West and East Vancouver Island basins experienced Level 5 drought conditions, the province's highest drought response level. Persistent high-pressure ridges redirected the jet stream and water-bearing clouds north, which made the summer of 2021 one of the driest in 75 years.[78]
2022	From July 19 to October 19, 2022, BC was North America's dry spot. During this period, only 13 mm of rain fell in Vancouver. Normally, the city receives 176 mm of rain. Las Vegas, Los Angeles, and Phoenix received more rain during this period than did Vancouver Island, the Lower Mainland, and the Gulf Islands.[79] By October 20, 10 basins in the province were experiencing Level 5 drought conditions (i.e., Fort Nelson; East, North and South Peace; Kettle; Eastern Pacific; Lower Mainland; East Vancouver Island; West Vancouver Island; and the Sunshine Coast).[78] The extensive and enduring drought prompted several communities in BC to declare states of local emergency, including the Sunshine Coast.

- Inability to access alternative, supplementary water sources due to high demand from competitors.
- Increased costs and reduced revenues related to responding to drought impacts.[81]

Although all water systems may be affected by drought, small water systems may be particularly vulnerable because of deficiencies in water system infrastructure, and they may have fewer technological, training, and financial resources.[82]

Drought can also affect community drinking water sources in different ways. For example, low source water levels could result in insufficient water supplies for firefighting.[83] Lower stream flows could result in warmer water temperatures that affect aquatic life, and could limit the amount of water that is available for crop irrigation.

All drinking water systems should prepare to respond to drought. Drought-resilient drinking water systems can respond to immediate water supply threats, withstand drought impacts, and recover quickly. Recovery includes considering long-term conditions and planning for permanent solutions.[84]

Drought-resilient utilities:

- Take action to protect human health and the environment while maintaining a minimum level of service for their customers during a drought.
- Manage reductions in water supply, increases in water demand, and changes in water quality.
- Plan for future changes in weather and climate patterns that can reduce water supply.[83]

For additional information on how to build drought resilience for water utilities, see the *Dealing with Drought: A Handbook for Water Suppliers in British Columbia*.[t]

The following case study from the Sunshine Coast Regional District (SCRD), located within the traditional territory of the shíshálh Nation, serves as an example of the type of impacts community water systems can face during a drought.

10.3.2 2022 Drought

Sunshine Coast

On October 7, 2022, the PHO and HLTH were advised that the drought situation across the province was worsening and that three regions (the Lower Mainland, West Vancouver Island, and the Sunshine Coast) were at drought level 5. The weather forecast indicated that the drought was expected to continue for a week or two, and there was potential for other regions in the province to enter drought level 5. As a result, advanced planning was undertaken.[85]

On October 11, the Ministry of Emergency Management and Climate Readiness ([EMCR] formerly Emergency Management BC [EMBC]) informed provincial agencies, including the PHO, that the SCRD estimated it would run out of water in 7 to 10 days.[86] EMCR worked with the SCRD to explore options for conducting enforcement of water use restrictions; using alternative water sources, such as emergency siphons of alternative/secondary reservoirs; accessing water from the Town of Gibsons through a mutual aid agreement; and using trucking to supply water to residents.[87,88]

On October 18, 2022, due to the imminent risk that the water supply for the Chapman Creek Water System would run out, the SCRD, District of Sechelt, and shíshálh Nation declared a state of local emergency.[89] Non-essential businesses (i.e., swimming pools, water bottlers, non-medical cannabis growers, breweries, distilleries, cideries, and companies involved in concrete, cement, asphalt, gravel and aggregate installation, repair, or cleaning) were required to stop using treated drinking water from the Chapman Creek Water System. An SCRD Board Chair indicated that the order was necessary to prioritize the water supply for essential use by residents and the Sechelt Hospital, and for fire protection.[90]

This measure followed water restrictions that were issued on August 31, 2022 and halted outdoor water use and prohibited producers from using water for irrigation, which impacted small farms in the region.[91] Other local business owners, who were concerned about the indeterminate length of the order, went into "survival mode" and modified their business practices (e.g., a local brewery stopped beer production and focused on selling products in their existing inventory).

The SCRD instituted proactive measures to curb water use in the region, including enforcing bylaws and issuing fines, sending letters to high-volume water users, delaying the opening of the local ice rink, and issuing water shutoff notices to residents who had not fixed pre-identified leaks.[87]

[t] *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/drought-info/dealing_with_drought_handbook.pdf*

The Sunshine Coast Regional District uses siphons to access emergency drinking water storage when water in Chapman Lake no longer flows naturally into Chapman Creek, 2022.

Photo credit: Sunshine Coast Regional District.

Following recalibration of its instruments, the SCRD determined it had greater water flow than previously identified. This, in conjunction with forecasted rainfall, prompted the SCRD to lift its state of local emergency on November 18, 2022.[92,93] However, the community remained on Stage 4 water conservation restrictions until December 13, when flows in Chapman Creek had improved.[94]

According to the British Columbia Drought Information Portal, this was the fourth time since 2015 that the Sunshine Coast had experienced drought level 4 or higher.[78]

The SCRD was not alone in dealing with water scarcity in 2022 (*Table 10.11*).

Table 10.11: Other BC Communities Impacted by Drought in October 2022

Regional Health Authority	Water System	Response
Vancouver Coastal Health	Lions Bay Size: 200 connections Population served: Max. 500 Size: 591 connections Population served: Max. 1,400	In October 2022, Lions Bay advised the health authority that its two creek sources (i.e., Magnesia Creek and Harvey Creek) and stored treated water levels were running low. As a result of low source water levels, the fixed water production rate of the two treatment plants (i.e., the time required for adequate treatment to occur within each treatment plant before the water is available for use) and the higher-than-usual water demand on the available treated water in storage from the community, the water system's storage tanks were taking considerable time to fill, which made it difficult to maintain stored water levels. While there was enough water in the storage tanks for firefighting, operators of the water system were concerned that if there was a fire event that required a response, the system would not be able to recover from the reduced water levels based on the current water treatment production rate.[95,96] Additionally, the ultraviolet (UV) treatment was running constantly to clean the water due to the increased water demand, and there was concern that the bulbs for the UV reactors would burn out. The community investigated how to maintain UV reactors and adjust systems to increase water levels.[88] Bylaw officers patrolled properties because water use was higher than normal.
	Montizambert Size: 150 connections Population served: Max. 500	On October 18, 2022, the water system reported it would need to start hauling water if there was no rain by end of the week. Fortunately, rainfall alleviated the situation.[95] Montizambert is operated by the District of West Vancouver and relies on Montizambert Creek for its water supply.[96]
	Mount Seymour Ski Resort Size: 10 connections Population served: Max. 5,000	The source supply for Mount Seymour Ski Resort is Scott-Goldie Creek, which is dammed to provide an open reservoir for the water supply system.[96] To save water for firefighting, the resort shut down operations of the resort facilities (e.g., public washrooms and food service).[95]
	Wigwam Inn Size: 2 connections Population served: Max. 150	Wigwam Inn is a yacht club destination site at the north end of Indian Arm that relies on Wigwam Creek for its water supply.[96] The inn reported having no water except for water in storage, so water use was restricted to the site's caretakers.[95]
Northern Health	Dawson Creek Size: 4,000 connections Population served: Max. 12,000	In 2022, the northeast of BC reached drought level 5 that lasted into the fall. The river that feeds Dawson Creek undergoes considerable seasonal fluctuation in volume and turbidity. As a result, the community had been building up their storage capacity to help mitigate the existing drought conditions.[97]

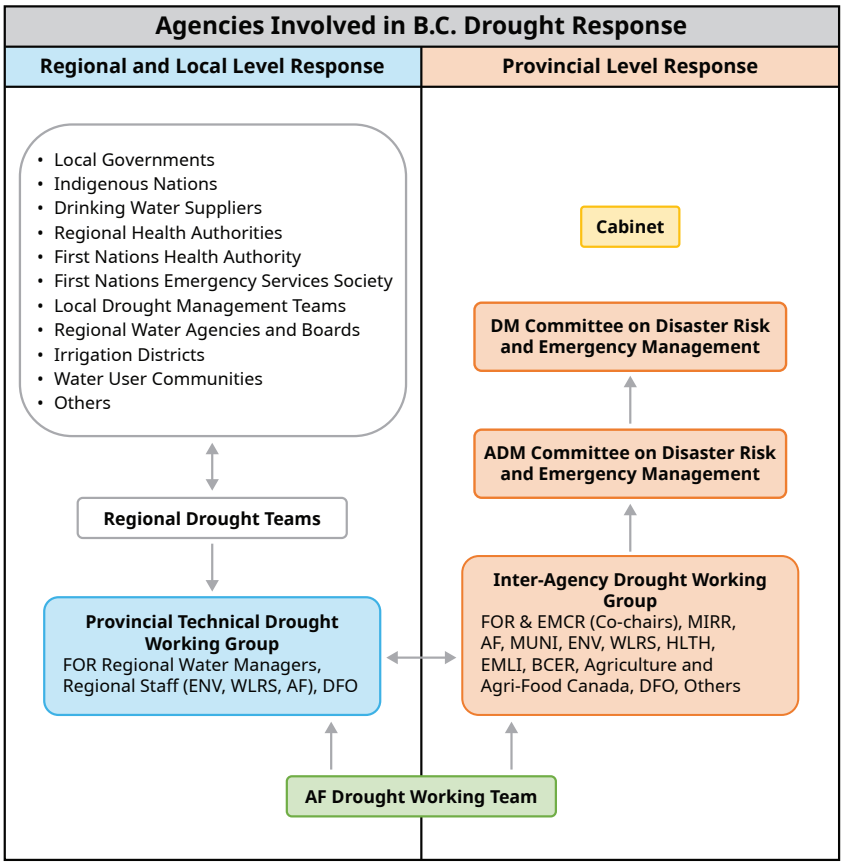
Note: Most of the systems impacted by drought in Vancouver Coastal Health stated that any fires would have decimated their water supply, which would have made it difficult to meet daily water demands.[95]

10.3.3 Drought Management

In BC, several local, regional, provincial, and federal agencies share responsibility for managing and responding to drought (*Figure 10.3*).

ENV administers the *Environmental Management Act*. The Ministry of Forests (FOR) is responsible for managing drought planning and response in BC, and administers the *Water Sustainability Act*. The Ministry of Water, Land and Resource Stewardship (WLRS) leads development of legislation and policy related to drought management, and oversees and coordinates the science required to assess and monitor impacts on water before, during, and after droughts. EMCR provides advice on, and historical context of, responses related to loss of water supply (potable water and firefighting); supports local governments during emergency response activities; supports provincial emergency response coordination, and provides support on pre-planning and risk assessment. The Office of the Fire Commissioner (formerly with EMBC but now with the Ministry of Public Safety and Solicitor General) provides support for Fire Code requirements related to water supplies for firefighting. HLTH provides policy development and guidance related to the DWPA and *Public Health Act*. The regional health authorities administer and enforce the DWPA, and health authority drinking water officers provide guidance to water suppliers and local governments on emergency coordination, preparedness, and response planning related to loss of water supply. For example, Island Health conducted drought surveys in 2021 and 2022 to

Figure 10.3: Agencies Involved in BC Drought Response



Note: ADM: Assistant Deputy Minister; AF: Ministry of Agriculture and Food; BCER: BC Energy Regulator; DFO: Fisheries and Oceans Canada; DM: Deputy Minister; EMCR: Ministry of Emergency Management and Climate Readiness; EMLI: Ministry of Energy, Mines and Low Carbon Innovation; ENV: Ministry of Environment and Climate Change Strategy; FOR: Ministry of Forests; HLTH: Ministry of Health; MIRR: Ministry of Indigenous Relations and Reconciliation; MUNI: Ministry of Municipal Affairs; WLRS: Ministry of Water, Land and Resource Stewardship.

Source: BC Drought and Water Scarcity Response Plan; April 2023.[98]

build its understanding of water suppliers' level of preparedness regarding drought.

Table 10.12 provides an overview of key provincial drought coordination committees.

For additional information on regulatory tools for preventing and managing drought, see section 10.3.4.

10.3.4 Provincial Drought Management Resources

There are several resources to help communities respond to drought, such as the *British Columbia Drought and Water Scarcity Response Plan*. Additional resources communities can use include the *Dealing with Drought: A Handbook for Water Suppliers in British Columbia*, British Columbia Drought Information Portal, ambient water and climate monitoring programs, BC Irrigation Water Use Calculator, Agriculture Water Demand Model, and Farmwest website (*Table 10.13*).

British Columbia Drought and Water Scarcity Response Plan

In collaboration with Agriculture and Agri-food Canada, the Province developed the *British Columbia Drought and Water Scarcity Response Plan*.[u] This plan, which was first published in 2010, is reviewed annually and includes information on:

- The responsibilities of provincial and local agencies in responding to drought.
- Recommended actions to take before the onset of drought, during drought, and after drought conditions have subsided.
- Drought response criteria to help decision makers determine when to elevate drought responses to higher levels.[98]

The 2021 edition of the plan includes changes to drought level definitions and criteria to better align with the North American drought monitoring frameworks, and it more accurately describes water scarcity in an area. BC's six-level drought classification system explains the severity of drought and the level of response required by communities and the provincial government: the higher the drought classification number, the greater the potential for adverse socio-economic and ecosystem impacts, and the greater response measures required (*Table 10.14*).

In some regions, First Nations are members of the Regional Drought Team. They provide real-time input into provincial drought response, which informs the review of the *British Columbia Drought and Water Scarcity Response Plan*. Annual updates to the plan also include First Nations engagement. For example, the First Nations Health Authority and Indigenous Services Canada identified their roles and responsibilities in drought response, which was incorporated into the 2023 plan update. More work needs to be done to align the plan with the United Nations Declaration on the Rights of Indigenous Peoples and the *Declaration Act*.

Table 10.12: Key Provincial Drought Coordination Committees

Group	Responsibilities
Inter-agency Drought Working Group	The Inter-agency Drought Working Group (IADWG) includes members from key provincial and federal government agencies. It is tasked with ensuring that the BC Drought Response Plan (discussed in Section 10.4.3) is delivered and strategic-level drought issues are addressed. The IADWG also develops and oversees drought response projects and ensures that roles and responsibilities during low water flow and drought conditions are clearly defined, communicated, and understood by both government and non-government parties.
Provincial Technical Drought Working Group	The Provincial Technical Drought Working Group (PTDWG) includes members from regional cross-government drought teams and from the Ministry of Forests, Ministry of Environment and Climate Change Strategy, Ministry of Water, Land and Resource Stewardship, Ministry of Agriculture and Food, and other agencies. The PTDWG coordinates operational-level cross-agency response to drought or stream low-flow conditions, and determines drought levels at the watershed scale and when to take regulatory action.
Regional Drought Teams	Regional drought teams advise on region- and watershed-specific drought response levels based on scientific data. They also issue advisories and notifications regarding drought conditions and support pre-drought preparedness (e.g., development of regional drought plans). Regional drought teams may include staff from provincial and federal government offices, representatives of local water users, local governments, Indigenous governments, water suppliers, non-government agencies, regional health authorities, and business and recreation sector groups.[98]
Ministry of Agriculture and Food Drought Working Team	The Ministry of Agriculture and Food drought working team assesses impacts of drought on dry land farming areas and range capacity to support livestock. The team provides lead drought response in non-irrigated areas and assesses livestock needs in drought-impacted areas. It also provides producers with information on drought programs and initiatives by liaising with the BC Agriculture Council and Agriculture and Agri-food Canada.[98]

[u] https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/drought-info/drought_response_plan_final.pdf

Table 10.13: Drought Response Resources

Resource	Description
Dealing with Drought: A Handbook for Water Suppliers in British Columbia	The Province created the *Dealing with Drought: A Handbook for Water Suppliers in British Columbia*[v] in response to climate change and the severe droughts of 2003 and 2015. The handbook is intended to provide drought management goals to help prevent the onset of drought conditions and to support water suppliers with assessing, planning, and responding to drought conditions and with coordinating internal and external communications.[100]
British Columbia Drought Information Portal	The Provincial Technical Drought Working Group provides drought level updates for each major watershed in the province, which are posted on the British Columbia Drought Information portal.[w] The portal was created as a single source of drought information for people living in BC. It includes maps of drought levels across the province, historical time-lapse information on droughts dating back to 2015, and drought information.[78]
Ambient Water and Climate Monitoring Programs Supporting Drinking Water Protection	Since 2020, the Ministry of Environmental and Climate Change Strategy has used data from the provincial Snow Survey program,[x] Provincial Groundwater Observation Well Network[y] (PGOWN), and Canada–British Columbia Hydrometric Program[z] to support water management, flood forecasting, and drought response activities.[66] Data from ambient provincial water quality monitoring programs are used to assess the status of, and water quality trends in, lakes and rivers across BC and are used to assess cumulative impacts on water sources throughout the province.[61] Additionally, long-term ambient networks (such as the PGOWN) provide publicly accessible information for assessing the impacts of major weather and climate events (such as the 2021 floods and heat dome) on source water.[66]
BC Irrigation Water Use Calculator	The BC Irrigation Water Use Calculator[aa] is a water management tool that was developed in 2020. It helps producers calculate their annual irrigation water use based on information that is specific to their farm, such as irrigation system run times and pump energy consumption. This is a free online tool for producers to track their irrigation water use and maintain it within their licensed volume.[68]
Agriculture Water Demand Model	The Agriculture Water Demand Model[bb] estimates the current and future water requirement for agriculture from surface water, groundwater, and reclaimed water sources. The model is operational in more than 25 regions in BC, and its results have served as baselines for local governments in developing water planning strategies. Many of these water plans are linked to source protection plans.[68]
Farmwest Website	The Farmwest website[cc] is a federal-provincial-territorial initiative that is supported by the Ministry of Agriculture and Food and is funded in part by the Sustainable Canadian Agricultural Partnership. The website provides historical weather information from more than 150 weather stations in BC, and decision-support tools for agricultural producers to make informed decisions about their daily farm operations, including irrigation and nutrient management. Farmwest improves public and producers' access to weather information in protecting our water sources.[68]

Table 10.14: BC's Drought Response Levels

Drought Level Classification		
Level	**Impacts**	**General Response Measures**
0	There is sufficient water to meet socio-economic and ecosystem needs	Preparedness
1	Adverse impacts to socio-economic and ecosystem values are rare	Conservation
2	Adverse impacts to socio-economic and ecosystem values are unlikely	Conservation; Local water restrictions where appropriate
3	Adverse impacts to socio-economic and ecosystem values are possible	Conservation; Local water restrictions likely
4	Adverse impacts to socio-economic and ecosystem values are likely	Conservation and local water restrictions; Regulatory action possible
5	Adverse impacts to socio-economic and ecosystem values are almost certain	Conservation and local water restrictions; Regulatory action likely; Possible emergency response

Source: BC Ministry of Environment and Climate Change Strategy. Drought Information; 2023.[99]

[v] *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/drought-info/dealing_with_drought_handbook.pdf*

[w] *https://governmentofbc.maps.arcgis.com/apps/MapSeries/index.html?appid=838d533d8062411c820eef50b08f7ebc*

[x] *https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-science-data/water-data-tools/snow-survey-data*

[y] *https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/groundwater-wells-aquifers/groundwater-observation-well-network*

[z] *https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-science-data/water-data-tools/provincial-hydrology-program/canada-british-columbia-hydrometric-program*

[aa] *https://bcwatercalculator.ca/irrigation/calculator*

[bb] *https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/water/water-management/agriculture-water-demand-model*

[cc] *http://farmwest.com*

10.4 Wildfire

BC is experiencing longer and windier hot seasons, warmer year-round weather, and more drought. These changes in the climate are making it easier for wildfires to ignite and spread. In recent years, record-breaking wildfires in terms of cost and area affected have occurred, and the annual area burned in BC is projected to increase due to climate change by 2050.[101]

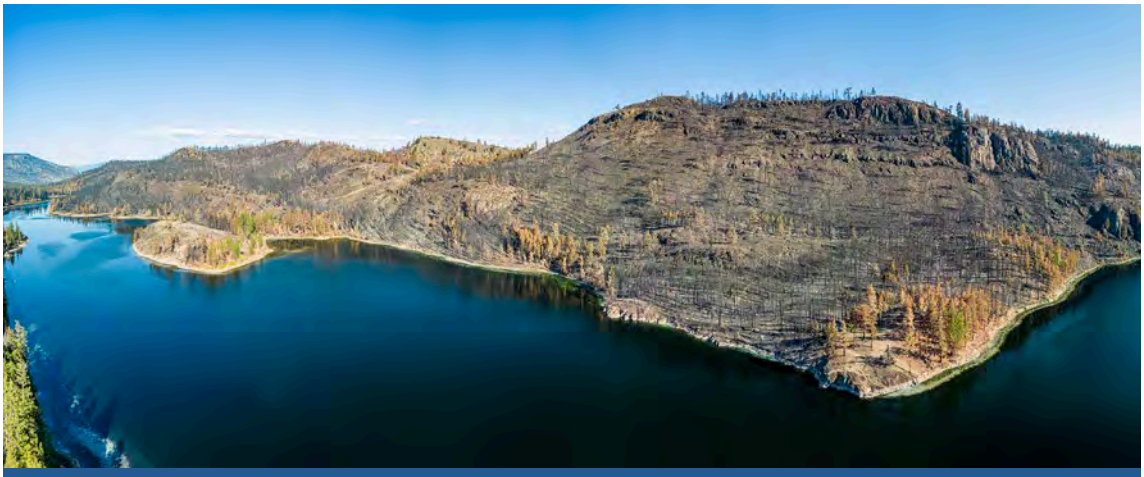
Wildfires are unplanned and uncontrolled fires that occur in natural areas, such as forests and grasslands. BC has always experienced wildfires; they typically are important to the life cycles of natural areas because they clear out dead plants, which creates space for new plants to grow. For example, pine trees need the heat from fires for their cones to open and release their seeds. However, when fires occur more frequently and burn hotter, natural areas do not always have time to recover.[102]

Climate change is negatively impacting the natural cycles of forests. Pests such as the mountain pine beetle usually die out during the coldest winter months. With warmer winters, they are able to survive. These pests damage and kill trees, which makes forests burn easily and quickly when a fire begins. Longer, hotter summers lead to more droughts and a longer wildfire season. Dry conditions make it easier for lightning storms to ignite fires and for strong winds to spread them. These conditions create fires that can spread, combine, and burn longer.[102] Decades of forest management practices that have suppressed the occurrence of fire have contributed to the current wildfire risk.

Healthy forests store carbon, an important driver of climate change, and keep it out of the atmosphere. When forests are lost to wildfires, they release a large amount of carbon into the air. Over time, increasing concentrations of atmospheric carbon can cause the climate to warm, which can result in more wildfires. Larger, hotter, more frequent wildfires increasingly threaten residents' homes and lives, which leads to increased numbers of evacuations and displacement of people.[102]

10.4.1 Impacts on Drinking Water due to Wildfire

The effects of wildfires pose risks to water supplies and potentially compromise the ability of water systems to deliver safe drinking water to the public.[103] When wildfires occur in remote forested watersheds, their impacts on water supplies, water quality, and stream health can extend far downstream and persist for many years. Wildfires can also turn into interface fires,[dd] which can do significant damage to water treatment, storage, and delivery infrastructure.



Fire damage at the Rose Valley Lake reservoir after the 2023 McDougall Creek wildfire in West Kelowna. The reservoir is the primary water source for the new Rose Valley Water Treatment Plant that will service 7,300 connections within West Kelowna, BC.

Photo credit: City of West Kelowna.

[dd] The BC Wildfire Service defines interface fires as those that have the potential to involve buildings and forest fuel or vegetation simultaneously.

Wildfires can affect drinking water quality and chemistry through:

- Changes in the amount and timing of snowmelt and runoff from storms due to a reduction of trees and plants, soil instability, and changes in the soil causing it to be more repellent.
- Changes in water quality due to increased soil erosion, sediment, fire debris, and the buildup of ash.
- Alterations to water aesthetics (e.g., taste, smell, colour, or clarity).
- Changes in water chemistry if fire retardant has been used because it may add phosphate, nitrate, and nitrite to a water system.[103]
- Mobilization of contaminants into the distribution system due to heat from interface fires.
- Degradation of water quality due to water stagnation in pipes or building plumbing when evacuations are ordered.
- Introduction of contaminants after pressure-loss events in the distribution system caused by high water demand (e.g., firefighting), power outages, damaged water mains, or failed pumping systems during an interface fire.[104]

The level of impact to water quality depends on the severity and size of the fire, the weather, the type of landscape, geology, and ecology of the watershed. Changes in source water quality can make it more difficult and costly for water treatment systems to produce safe drinking water. Treatment works are designed for operation under certain water quality conditions. Sudden changes in water quality and spikes of turbidity in the water may render treatment ineffective and cause an increase in the use of chemicals. Excessive debris and sediment may cause reservoirs to fill and can also damage filters and other treatment works, therefore increasing maintenance costs.[103]

In the event of a wildfire, water suppliers should check the state of their water systems and the quality of drinking water. Any concerns should be communicated to the users. If drinking water is obtained from a private well or surface water source (e.g., lake or stream), the following signs could indicate that a water supply has been impacted by wildfires:

- Fires have occurred at or upstream of the water intake.
- Alterations to water aesthetics (e.g., taste, smell, colour, or clarity).
- Power outages have occurred or fire has damaged water system infrastructure (e.g., water intake structures, well heads, treatment plants, storage facilities, pump stations, and/or piping).[103]

Fire retardants or foams are commonly used to fight wildfires in BC. When good practices are followed, there is little risk to human health and the environment. The most commonly used fire retardant in BC is nearly 90 per cent water. A nitrogen-based product, similar to fertilizer, is added along with small amounts of additives to make the retardant more effective. These additives colour the retardant red so firefighters can see where it is has been applied.[103]

If fire retardant has entered drinking water sources, it may cause a temporary increase in nitrate/nitrite or turbidity levels, however it is unlikely to cause a human health concern due to the low volume. Drinking water that is obtained from sources where fire retardants have been used should be checked to ensure the levels of certain parameters do not exceed those in the *Guidelines for Canadian Drinking Water Quality*:

- Nitrate – 45 mg/L as nitrate or 10 mg/L as nitrate-nitrogen.
- Nitrite – 3 mg/L nitrite or 1 mg/L as nitrite-nitrogen.
- Turbidity (cloudy or unclear water) < 1.0 NTU after treatment.[103]

The most commonly used firefighting foam in BC is typically more than 99 per cent water. It does not contain any hazardous ingredients or per- and polyfluoroalkyl substances. It is golden brown and has an orange blossom odour and liquid appearance. Foams are typically used directly on open flames and are likely to burn off during use; therefore, it is unlikely that they will enter into drinking water sources.[105]

Predicting the long-term impacts of wildfires on drinking water quality can be challenging. Problems may arise long after the wildfire is over (e.g., during intense rainfall events in the fall/winter). Large amounts of hanging or dissolved material (such as ash) on burned land and in forests may wash into downstream drinking

water sources. This can cause maintenance and health concerns through:

- Increased debris in water reservoirs.
- More algae blooms in reservoirs.
- Increased turbidity (water cloudiness), which could cause sludge to become stuck in water filters or more chemicals to be needed for water treatment.
- Water chemistry changes, such as increases in dissolved organic carbon concentrations or in iron and manganese concentrations. This may cause changes in water colour or increased turbidity (requiring additional filtration) of the water and may lead to the formation of disinfection by-products (e.g., trihalomethanes) which will require further treatment.[103]

In addition, the intense heat of a wildfire can cause thermal degradation of plastic water pipes (e.g., PVC, HDPE, PEX). A study conducted in the aftermath of the wildfires that occurred in California in 2017, 2018, and 2020 showed that thermal degradation of plastic drinking water pipes can be a source of volatile organic compounds (VOCs), which can contaminate drinking water.[106] In addition, benzene, toluene, ethylbenzene, and xylene can be produced, which can then leach into the water when plastic pipes cool. The contaminants produced varied by the brand and type of plastic, as well as the temperature to which the pipes were exposed. Additionally, tentatively identified compounds, consisting primarily of aliphatic hydrocarbons, saturated ketones, or aromatic compounds, were found in the water and in the leachate of burned plastics. Water contaminated with these compounds could be drawn further into plumbing lines or the larger distribution system and cause contamination of additional end points.[106] The Purdue University Center for Plumbing Safety[ee] provides several resources for homeowners and public health officials to respond and recover from wildfire-caused drinking water contamination.

The chemicals generated by thermal degradation of plastic drinking water pipes can impact human health to varying degrees. Short-term exposure can lead to respiratory symptoms and central nervous system problems (headaches, dizziness); high exposure over long periods can cause kidney and liver damage, and potentially leukemia and other forms of cancer.[106] The study on the thermal degradation of plastic water pipes after the California wildfires showed that concentrations of VOCs in drinking water were well in exceedance of acceptable concentrations based on both the United States and Canadian guidelines.[107,108] Many variables can influence the concentration of VOCs that leach into drinking water due to thermal degradation of plastic water pipes, such as how long the water has been stagnant in the pipes, the types of additives that are in the pipes, the brand of pipe, and the loss of VOCs as they are emitted to the air over time.[106]

Road closures due to wildfire can also restrict access to communities and cause them to become isolated. In addition, impacts on transportation networks may disrupt water supply chains and prevent timely access to water testing laboratories.

10.4.2 Wildfire Impacts – Examples from Interior BC

The frequency, extent, and intensity of wildfires is increasing in BC, and the interior of the province is experiencing the brunt of these wildfires, particularly interface fires. Climate studies have tracked long-term changes in air temperature, which is considered to be the most easily measured and observable indicator of climate change.[109] Average temperatures in BC (recorded for 1900–2013) during the summer and winter have increased by 1.4°C and 2.2°C, respectively, and the annual minimum temperature has increased by 2.0°C.[109] These increases can lead to changes in physical and biological processes that can affect the risk of wildfire across the province. Wildfire events can adversely affect communities and public health in a variety of ways. This section focuses on how they can impact water supply systems, infrastructure, and operations, using examples provided by Interior Health.

Within Interior Health, a large number of permitted water supply systems have been affected by wildfires that have caused damage and/or triggered an evacuation order (*Table 10.15*). As a result of 26 wildfire events that occurred from 2020 to 2022, 215 water supply systems were affected by an evacuation order; most were affected during the 2021 wildfire season. Unfortunately, Interior Health's data system does not capture administrative data on system evacuations due to wildfires; thus, information

[ee] *https://engineering.purdue.edu/PlumbingSafety/resources/wildfire-response*

was obtained from records from incident command posts, which resulted in a limited data set.[110] Therefore, the number of water supply systems listed in *Table 10.15* that were affected by an evacuation order is not directly correlated with the extent of wildfire-related impacts on infrastructure. Additionally, the way in which each system is affected by an evacuation order is highly variable and can range from direct fire damage to infrastructure to minor operations disruptions, such as crews being unable to conduct routine sampling or maintenance.[111]

Table 10.15: Number of Water Supply Systems Affected by an Evacuation Order due to a Wildfire Event within the Interior Health Region, 2020 to 2022

Year	Wildfire	Number of Systems Affected
2020	Sage Mesa	1
	Talbot Creek	6
	Mount Christie	1
2021	Brenda Creek	42
	Lytton Creek	14
	Sparks Lake	8
	Embleton Mountain	1
	Bews Creek	1
	South of Canim Lake	5
	Tremont Creek	21
	Flat Lake	21
	Nk'Mip Creek	7
	Bill Nye	1
	Octopus Creek	2
	Michaud Creek	3
	Three Valley Lake	3
	2 Mile Rd	7
	Durand Lake	3
	White Rock Lake	35
	Young Lake Fire	7
	Big Stick Lake	2
	July Mountain	2
	Crazy Creek	1
	Garrison Lake	3
	Mount Law	1
2022	Keremeos Creek	17
Total	–	**215**

Source: Interior Health Authority; 2023.[110]

A certified water and wastewater operator from Lytton First Nation on the front lines helping fight the Lytton Creek wildfire, 2021.

Photo credit: Warren Brown, CWP CWWP, Operations & Maintenance Manager, Lytton First Nation. Environmental Operators Certification Program Operator Digest – Winter 2022/Number 151.Reproduced with permission.

The following case studies from the Lytton Creek, Nohomin Creek, and White Rock Lake wildfires illustrate some of the challenges wildfire-impacted drinking water systems can face.

Lytton Creek Wildfire

Leading up to the 2021 wildfire season, the northern half of BC received average to above-average snowfall, whereas the southern half recorded below-average precipitation over the fall and winter. As a result, the southern regions carried extended drought conditions into April, May, and June. The Okanagan, Cariboo, far southeast, and eastern side of the Rocky Mountains reported the highest fire hazard ratings in the province throughout the spring.

The Village of Lytton, located on the traditional territories of the Lytton First Nation at the confluence of the Thompson and Fraser Rivers, is the "hot spot" of BC's interior. On June 30, 2021, a wildfire destroyed 39 homes within the Lytton First Nation community and 112 homes and businesses within the Village of Lytton (approximately 90 per cent of the properties within the village), and claimed the lives of two people. The wildfire burned more than 80,000 ha (800 km^2) before it was brought under control. It is estimated that more than 1,000 residents were evacuated from the area; most were unable to return home. In the days leading up to the wildfire, temperatures in the area exceeded Canadian record highs by reaching almost 50°C.[112,113]

As a result of the wildfire, the community water system was placed on a boil water notice, which was later upgraded to a do not consume notice due to direct damage to the water system infrastructure, such as well heads, control buildings, and distribution lines. The notice remained in place until December of that year and was lifted only for the reoccupied sections of Lytton following an extensive sampling program that was conducted in coordination with the First Nations Health Authority. The unoccupied areas and other fire-damaged parts of Lytton remain on a do not consume notice.[114]

The Village of Lytton developed a short-term recovery plan, which highlighted the areas of the community that required immediate attention, and indicated that a comprehensive scope and scale of loss assessment was required for public infrastructure. The assessment includes the reestablishment of critical infrastructure, such as water and sewer. The Village has engaged with the provincial Disaster Financial Assistance program to assist with this work.

The new replacement well at Lytton First Nation to replace Well # 3 that was destroyed in to 2021 Lytton wildfire. The system pumps the water up to the Village of Lytton water system, where it is treated and sent to the reservoir. Well # 3 works with the Village of Lytton's Well # 2 to feed the system. During the summer, the Village uses a creek source. The wells are used when the creek source becomes too low or when turbidity levels and raw water quality interfere with the effectiveness of the treatment plants ultraviolet disinfection.

Photo credit: Warren Brown, CWP CWWP, Operations & Maintenance Manager, Lytton First Nation.

In July 2022, the Nohomin Creek wildfire threatened the Lytton First Nation slow sand filtration Water Treatment Plant for the Stein Water System. The system services 200 connections and over 500 band members. Heavy equipment was used to scrape a fire guard around the building.

Photo credit: Warren Brown, CWP CWWP, Operations & Maintenance Manager, Lytton First Nation.

Recovery efforts for the Village of Lytton have progressed slowly. Full return of water service was intended to occur by the fall of 2022. However, this deadline was not met due to several factors, including the flooding in 2021, which caused a loss of highway access that affected transportation and the shipment of materials, water system treatment failures and malfunctions that resulted in the issuing of a new boil water notice, and changes within the community's administration.[114]

Nohomin Creek Wildfire

Just one year after the devastating Lytton Creek wildfire, the Nohomin Creek wildfire ignited on July 14, 2022, 1.7 km northwest of the Village of Lytton within the traditional territory of the Lytton First Nation. To protect homes in the community, the Lytton First Nation fire team collaborated with the BC Wildfire Service to combat the fires held on the flanks, and to protect cultural and BC Parks values. Per the *Stein Valley Nlaka'pamux Heritage Park Management Plan*, a cultural values and archaeology specialist from Lytton First Nation worked with structure protection specialists and BC Wildfire crews to identify cultural values in the Stein valley bottom and provide guidance on how best to protect those values and the watershed.[115]

Power outages lead to a lack of available water, which resulted in bottled water being distributed and a fill station being set up. Generators were brought in to power the four water systems in the area that were impacted by the fire. The systems were placed on a boil water notice due to pressure losses caused by the lack of power, and residences who did not have power to boil their water were given bottled water. A plan was put in place to remove the boil water notice. It involved resuming water disinfection once power was restored, and then conducting two rounds of bacteriological sampling and testing to remove the notice.[116]

White Rock Lake Wildfire – Killiney Beach

In late summer 2021, the White Rock Lake wildfire impacted communities in the Central Okanagan West area off Westside Road near the northern boundary of the Regional District of Central Okanagan within the traditional territory of the Okanagan Indian Band (also know as the Syeelhwh Nation). The wildfire had burned 83,342 ha (833 km^2) by the time it was brought under control.[117] In total, 35 water systems were affected by an evacuation order. Evacuation alerts/orders were issued for communities in the Central and North Okanagan, including (but not limited to):

- Okanagan Indian Band (order)
- Westwold (order)
- City of Vernon (alert)
- City of Armstrong (alert)
- Spallumcheen Township (alert)[118]

Assessments confirmed that a total of 75 properties in the Eastmont, Killiney Beach, and Beau Park areas had sustained significant damage. No structures in Westshore Estates were lost or significantly damaged.[119]

Many of the residences that were damaged or destroyed by the wildfire were connected to the Killiney Beach Water System. This resulted in system-wide loss of pressure until the affected areas could be isolated. The water system was brought back online to provide water for firefighting, even though the system continued to lose large volumes of water. Loss of pressure, even short-term pressure changes, along with damaged water distribution and service lines can result in chemical and biological contamination of a water system, which may have long-term impacts on the system's infrastructure. The community was issued a do not consume notice on August 30, 2021.[120]

The scope of the damage and the effects on the water supply system were beyond the expertise of regional district staff. There were considerable concerns about chemical contamination of the water supply, which may not have been clearly visible in the direct aftermath of the fire.[120] It was recommended that a qualified professional engineer be retained to determine:

- The nature and extent of damage to the water system infrastructure.
- The degree, if any, of chemical and biological contamination of the water distribution system infrastructure.
- The damage that required immediate repair to prevent further contamination of the water distribution system.
- The damage that required immediate repair to prevent water loss that could contribute to pressure changes and the introduction of contaminants.[120]

The regional district contracted Associated Engineering to conduct an infrastructure assessment and create a recovery plan.[121] The infrastructure assessment determined that:

- All damaged service connections were properly closed off and repairs were completed, which reduced the amount of water leakage to below pre-fire levels.
- Pressure was being maintained in the distribution system, which reduced the potential for back flow or back siphonage.
- Samples were collected from eight locations throughout the Killiney Beach Water System on October 30, 2021. The regional district provided a copy of the sampling results to Interior Health on November 9, 2021.
- Routine bacterial testing conducted in September and October met bacterial standards set out in Schedule A of the Drinking Water Protection Regulation.
- A cleaning, disinfection, and unidirectional flushing program was completed on November 5, 2021.[121]

The do not consume public notification issued for the Killiney Beach Water System was rescinded on November 10, 2021.[121]

10.4.3 Opportunities for Wildfire Mitigation

Interior Health has expressed a commitment to responding to climate change and mitigating impacts on public health, including from the increased frequency and intensity of wildfires. Increased wildfire activity in BC is having a major impact on public health, and there is a growing body of evidence that practical interventions provide tangible health protection benefits.[122]

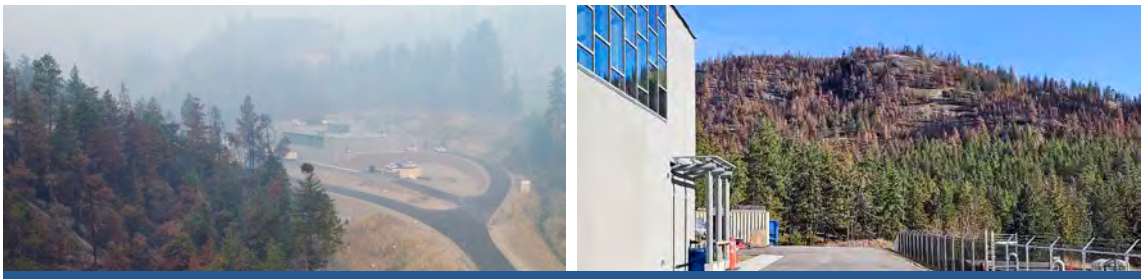
Table 10.16 outlines opportunities that could enable drinking water systems to mitigate wildfire impacts based on Interior Health's experience in emergency response and engagement with interested parties in the Interior. While many of the lessons learned on mitigation strategies pertain to wildfire, many of them would also increase water system resilience to other climate-related events.

Table 10.16: Wildfire Mitigation Strategies and Opportunities

Mitigation Strategies	Opportunities
1. Critical Infrastructure Mapping	BC Emergency Management Common Operating Picture includes information on critical infrastructure assets to support coordinated response and protection activities. Community drinking water infrastructure and critical watershed supply/recharge areas should be recognized as critical, and should be included in the provincial emergency response system.
2. Recovery Assessment and Planning	The nature and extent of damage to water system infrastructure from wildfire may not be clearly visible, yet may introduce chemical contamination over time. Operating the water system as normal (e.g., transferring water between pressure zones in the distribution system) and insufficient monitoring may lead to contaminant exposure. There is little guidance for water suppliers on how to engage the qualified professionals needed to assess their specific water infrastructure and coordinate a safe and timely return to full service. Having a plan in place for system-wide flushing of the distribution system in advance of an emergency incident will assist in system recovery.
3. Funding Sources and Protocols	During a declared emergency event, all permitted community water suppliers have access to emergency funding (i.e., for sampling, assessments, engineering) from provincial agencies or through internal emergency funds and insurance. However, a lack of clarity on how to access these funds and what each funding source can be used for has led to delays and ongoing precautionary advisories.
4. Mutual Aid Agreements	Communities rarely have the capacity to respond to all emergencies on their own. Municipal mutual aid agreements, which lay out the framework and procedures for communities to access, manage, and repatriate services and operators from neighbouring water suppliers are an asset. Ensuring agreements are in place and are current is important to creating community resilience in the face of increasing frequency and intensity of climate-related emergencies.
5. Backflow Devices and Cross-connection Control	A robust cross-connection control program with properly tested and maintained backflow prevention devices reduces the risk of contamination from a loss of pressure in the distribution system during high-flow conditions required for firefighting. A loss of pressure can cause a backflow of water from industrial or domestic connections into the water supply.
6. Protection of System Components	The use of fire-resistant materials where possible and burying pipes below the frost line may help protect water system elements from wildfire damage. Surface water intakes should be designed to adequately handle seasonal and extreme changes in flow and to protect them from increased flows of debris.
7. Back-up Water Sources	Having more than one water source or access to a back-up emergency source of water can increase water system resiliency. Operators of water systems should also plan for the provision of emergency supplies where an alternative water source is not accessible (e.g., bulk water hauling, bottled water, mobile treatment units).
8. Structural Protection Best Practices	The following key practices may support structural protection crews and help avoid direct wildfire damage: **a. Provision of clean water:** The sprinkler systems used by crews to protect homes during a wildfire should be cleaned regularly to prevent clogging. **b. Power backup by generators:** In almost all severe interface fires, power supply has been disrupted. In cases where generators are not permanently installed at key pumping stations, there should be an ability to quickly install temporary generators to ensure water supply is maintained. **c. Adequate pressure:** Structural protection sprinklers are designed and should be installed to operate at ≥ 60 psi pressure to ensure optimal coverage. **d. Adequate flow:** Structural protection of large structures requires a water supply of ≥ 40 Lpm. **e. Water storage recovery:** Ideally, storage can be fully recovered within 4–6 hours to ensure crews can respond to cycles in the wildfire activity. **f. Mapping and documentation of pumping stations:** Having accurate and accessible information on the location and capacity of pumping stations for firefighting personnel is essential for prompt and effective response. **g. Aerial identification of reservoir roofs:** Making critical infrastructure that is located at the fringe of the community clearly visible from the air is a simple, practical step (e.g., painting blue drops on the roof to identify the drinking water asset from above) to ensure aerial crews can target their suppression efforts. **h. FireSmart practices:** Application of British Columbia FireSmart[ff] practices to minimize fuel sources, reduce vulnerability of structures and water system components to fire damage, and support firefighting plans provides the most value per unit investment of any wildfire mitigation efforts.

Source: Interior Health Authority, 2021.[122,123]

[ff] *https://firesmartbc.ca*



In 2023, the McDougall Creek wildfire in West Kelowna threatened the newly constructed, not-yet commissioned Rose Valley Water Treatment Plant by burning up to the perimeter of the property (left). Due to pre-planning with a wildfire expert during the design phase, dedicated firefighting efforts, and installation of sprinklers on the roof by firefighters, the $75 million facility was spared direct damages (right); however, surrounding fire damage and water quality impacts delayed completion of the project.

Photo credit: City of West Kelowna, BC.

10.4.4 Provincial Actions – Wildfire

Budget 2022 allocated $359 million to reduce wildfire risk and support prevention and preparedness.[102] Several programs and initiatives have been enacted:

- Community Resiliency Investment Program[124]
- Wildfire risk reduction and cultural and prescribed burning[125]
- Forest landscape planning[126]

Additional actions taken to mitigate wildfire risks include:

- Conducting wildfire risk reduction, reforestation, and forest rehabilitation through the Forest Enhancement Society of BC.
- Investing in projects through StrongerBC[99] that will reduce the risk of wildfires on Crown land.
- Improving predictive services models to improve wildfire preparedness and response activities.[127]
- Providing practical advice to British Columbians on how to reduce wildfire risk around their homes and properties using the *BC FireSmart Begins at Home Manual*.[128]
- Developing a farm and ranch wildfire guide and workbook, and instructional videos to help farmers and ranchers prepare for future wildfires (developed by the Climate Change Adaptation Program).[129]

10.5 Conclusion – Lessons Learned and Next Steps Toward Ensuring Drinking Water Resiliency

Between April 1, 2017 and March 31, 2022, BC experienced several unprecedented flooding events, wildfires, droughts, and heat events that led to widespread impacts across the province and damage to critical infrastructure, such as water supply systems. Unfortunately, climate-related events are occurring at increasing frequency and scale, which is further challenging public health protection programs regarding drinking water. Emergency response and recovery from such events draws on resources and staff involved in public health protection, which were already stretched thin during the pandemic response, as highlighted in Section 7.1 (Chapter 7) and Chapter 9 of this report.

These events have demonstrated the clear need for ongoing and further provincial climate resiliency, preparedness, and disaster response planning and coordination regarding drinking water to better equip drinking water officers, water suppliers, local governments, First Nations, laboratories, and the Province to respond. Plans must be developed in alignment with processes outlined in the *Declaration on the Rights of Indigenous Peoples Act* and must provide clarity on roles and responsibilities during such events; effective communication is key. The plans must consider supply chain shortages, and contingency plans must be developed to ensure routine water sampling is maintained when transportation networks are impacted. To assist in emergency response, mapping of critical infrastructure for drinking water and wastewater is needed. Plans for educating, and communicating with, owners of private water supplies are also needed, as are plans for sampling of private systems when source water supplies are contaminated.

During the 2021 floods and fires, drinking water officials identified the need for assistance with inventorying water supply damages and making

[99] https://strongerbc.gov.bc.ca

recommendations for improvements to ensure resilient water supply systems are maintained. Improvements regarding information on how to access disaster financial assistance for water suppliers are also needed. Health officials from Interior Health reported that the lack of clarity in processes for accessing funds and about how each funding source could be used may have led to delays in accessing funds for necessary repairs and ongoing precautionary advisories during the 2021 floods.[41] Financial assistance and emergency support and assessments for small water systems that are not owned and operated by a local government are needed to help prevent those systems from falling into a state of disrepair as a result of natural disasters. Additionally, municipal mutual aid agreements, which lay out the framework and procedures for communities to access, manage, and repatriate services and operators from neighbouring water suppliers, promise to be valuable assets for ensuring drinking water resiliency. Further support could be provided by Emergency Response Teams, as described in Section 9.4.2 (Chapter 9).

The effects of climate change, such as rising temperatures, changes in precipitation patterns, increased frequency of severe weather events, and prolonged droughts will continue to affect water quality and quantity, and challenge the capacity of drinking water supply systems, operators, and drinking water protection programs. Implementing effective and equitable adaptation measures can reduce the impacts of climate change and protect population health.[45] A coordinated, collaborative, and cross-sectoral approach is required to reduce water-related health risks associated with climate change and to build resilient drinking water infrastructure.[1]

As the climate events of 2021 demonstrated, climate change is already impacting the health of people living in BC. Thus, increasing the resilience and adaptation capacity of our health system (all organizations, people, and actions whose primary intent is to promote, restore, or maintain health) and critical infrastructure, including drinking water systems, is required to minimize health impacts and must occur in concert with efforts to reduce greenhouse gas emissions.[45]

In 2018, the Province released the CleanBC climate action plan, followed by a Preliminary Strategic Climate Risk Assessment in 2019 and the provincial Climate Preparedness and Adaptation Strategy in 2022. Health emerged as a cross-cutting issue in the Preliminary Strategic Climate Risk Assessment: health consequences ranged from minor to catastrophic for 12 of the 15 climate-related risks assessed.[130] To enhance the provincial health system's capacity to anticipate, prevent, prepare for, and manage climate-related health risks, HLTH is advancing foundational actions under the Climate Preparedness and Adaptation Strategy in 2022–2025 to:

- Assess climate impacts on health and the health system to inform adaptation and resilience planning.
- Build health sector workforce knowledge and capacity and public health awareness to prepare for, and respond to, climate-related health impacts.
- Promote cross-sectoral collaboration on innovative, evidence-based solutions that are grounded in cultural safety and health equity.[130]

HLTH established the Climate Resilience Unit in 2022 to support and coordinate implementation of the Climate Preparedness and Adaptation Strategy in collaboration with regional health authorities and other partners. The unit supports the integration and coordination of effective, efficient, and equitable health sector responses to climate change. This includes working with diverse partners and program areas to promote climate-informed health policies and health-informed climate policy, including for drinking water.[130] Because this work is just beginning, it is too early to evaluate its effectiveness.

Meeting Obligations to Honour First Nations Wisdom Related to Climate Change and Drinking Water

We recognize that BC First Nations, whose ancestral territories cover all of the province now known as British Columbia, are holders of inherent rights and title, and have tremendous wisdom to share about how to care for the lands and waters throughout this province. Settler activities on these lands have caused harm and have contributed to climate change. Now, First Nations in BC are experiencing significant impacts, including those due to floods and wildfires in their traditional territories.[131,132,133] Wisdom from BC First Nations is required to address climate change, including protecting and caring for the water we drink.

REFERENCES

[1] Takaro, T., Enright, P., Waters, S., Galway, L., Brubacher, J., Galanis, E., McIntyre, L., Cook, C., Dunn, G., Fleury, M. D., Smith, B., & Kosatsky, T. (2022). Water quality, quantity, and security. In P. Berry & R. Schnitter (Eds.), Health of Canadians in a changing climate: advancing our knowledge for action. [Internet]. Ottawa, ON: Government of Canada. Available from: *https://changingclimate.ca/health-in-a-changing-climate/chapter/7-0/*.

[2] Klassen, J., & Allen, D. M. (2017). Assessing the risk of saltwater intrusion in coastal aquifers. Journal of Hydrology, 551, 730–745. Available from: *https://www.sciencedirect.com/science/article/abs/pii/S0022169417301233?via%3Dihub*.

[3] Natural Resources Canada. Canada in a changing climate: regional perspectives report, British Columbia. [Internet]. Ottawa, ON: Government of Canada; 2021. Available from: *https://changingclimate.ca/regional-perspectives/chapter/5-0/*.

[4] BC Ministry of Environment and Climate Change Strategy. Preliminary strategic climate risk assessment for British Columbia – summary of results. [Internet]. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; 2019. Available from: *https://www2.gov.bc.ca/assets/gov/environment/climate-change/adaptation/climate-risk-summary.pdf*.

[5] BC Ministry of Forests, Emergency Management BC. From flood risk to resilience in B.C.: intentions paper. [Internet]. Victoria, BC: BC Ministry of Forests, Emergency Management BC; 2023. Available from: *https://engage.gov.bc.ca/app/uploads/sites/797/2022/10/From-Flood-Risk-to-Resilience-in-B.C.pdf*.

[6] Natural Resources Canada. Health of Canadians in a changing climate: advancing our knowledge for action. [Internet]. Ottawa, ON: Government of Canada; 2022. Available from: *https://changingclimate.ca/health-in-a-changing-climate/*.

[7] Zhang X, Flato G, Kirchmeier-Young M, Vincent L, Wan H, Wang X, Rong R, Fyfe J, Li G, and Kharin V.V. Temperature and precipitation across Canada; Chapter 4. Canada's changing climate report. [Internet]. Ottawa, ON: Government of Canada; 2019. Available from: *https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/Climate-change/pdf/CCCR-Chapter4-TemperatureAndPrecipitationAcrossCanada.pdf*.

[8] BC Ministry of Transportation and Infrastructure. BC highway flood recovery projects. [Internet]. Victoria, BC: BC Ministry of Transportation and Infrastructure; [cited 2023 Feb 14]. Available from: *https://www2.gov.bc.ca/gov/content/transportation-projects/bc-highway-flood-recovery*.

[9] Emergency Management BC. City of Abbotsford atmospheric river impacts and recovery. [Internet]. Available from: *https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/reports/abbotsford-community_summary.pdf*.

[10] Environment and Climate Change Canada. Canada's top 10 weather stories of 2021. [Internet]. Ottawa, ON: Government of Canada; 2021. Available from: *https://www.canada.ca/en/environment-climate-change/services/top-ten-weather-stories/2021.html*.

[11] British Columbia Assembly of First Nations. Impacted Indigenous communities report #6. 2021 Nov 17. [Internet]. Available from: *https://www.bcafn.ca/sites/default/files/docs/news/21NOV2021_IndigenousImpactsReport.pdf*.

[12] City of Abbotsford. Water & Wastewater. [Internet]. Available from: *https://www.abbotsford.ca/city-services/water-wastewater*.

[13] City of Abbotsford. Annual water quality report, 2021. [Internet]. Available from: *https://www.ourwatermatters.ca/sites/1/files/2022-06/2021%20Annual%20Water%20Quality%20Report.pdf*.

[14] Choquette, B. Personal communication. Fraser Health; 2021 Nov 21.

[15] Martin, M. Personal communication. Ministry of Municipal Affairs; 2023 Jul 31.

[16] Emergency Management BC. City of Merritt atmospheric river impacts and recovery. [Internet]. Available from: *https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/reports/merritt-community_summary.pdf*.

[17] SNC-Lavalin. Summary of results: Merritt preliminary regional risk assessment for contamination related to the 2021 atmospheric river event. [Internet]. [Prepared for: BC Ministry of Environment and Climate Change Strategy]. Burnaby, BC: SNC-Lavalin; 2022 Jun 29. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/flood-response-and-the-environment/water-quality/merritt_preliminary_regional_risk_assessment_summary.pdf*.

[18] Yamada, C. Personal communication. Interior Health; 2023 May 01.

[19] EOCP. 2022 Spring Operator Digest. Environmental Operator Certification Program. [Internet]. Available from: *https://eocp.ca/wp-content/uploads/2022/04/2022_Spring_Operator_Digest.pdf*.

[20] City of Merritt. 2021 flood review + repair. [Internet]. Available from: *https://www.merritt.ca/flood/*.

[21] Norlin, I. Personal communication. Interior Health; 2023 Feb 17.

[22] Interior Health Authority. Merritt case study draft v2; [unpublished]. Interior Health Authority; May 11, 2023.

[23] Martin, M. Personal communication. BC Ministry of Municipal Affairs. 2023 Sep 08.

[24] SNC-Lavalin. Summary of results: Princeton preliminary regional risk assessment for contamination related to the 2021 atmospheric river event. [Internet]. [Prepared for: BC Ministry of Environment and Climate Change Strategy]. Burnaby, BC: SNC-Lavalin; 2022 Jun 29. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/flood-response-and-the-environment/water-quality/princeton_preliminary_regional_risk_assessment_summary.pdf*.

[25] Emergency Management BC. Town of Princeton atmospheric river impacts and recovery. [Internet]. Available from: *https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/reports/princeton-community_summary.pdf*.

[26] Birtles, R. Personal communication. Interior Health; 2021 Nov 16.

[27] Edwards, J. BC Ministry of Health. Draft information note [unpublished]; 2021 Dec 13.

[28] Norlin, I. Interior Health. Personal communication; 2023 Feb 14.

[29] BC Ministry of Environment and Climate Change Strategy and GeoBC. Flood Water Quality Monitoring Task Force Hub. [Internet]. Available from: *https://fwqmtf-bcgov03.hub.arcgis.com/*.

[30] SNC-Lavalin. Summary of results: Sumas Prairie preliminary regional risk assessment for contamination related to the 2021 atmospheric river event. [Internet]. [Prepared for: BC Ministry of Environment and Climate Change Strategy]. Burnaby, BC: SNC-Lavalin; 2022 Jun 29. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/flood-response-and-the-environment/water-quality/sumas_prairie_preliminary_regional_risk_assessment_summary.pdf*.

[31] Government of British Columbia. Updated summary of results – December 2022: Sumas Prairie preliminary regional risk assessment for contamination related to the 2021 flood. [Internet]. Available from: *https://nrs.objectstore.gov.bc.ca/xedyjn/Projects/2022/CSM/Sumas_Plain_Language_Summary.pdf*.

[32] Government of British Columbia. Code of Practice for Agricultural Environmental Management (AEM). [Internet]. Victoria, BC: Government of British Columbia. Available from: *https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/8_2019*.

[33] Government of British Columbia. Environmental Management Act (EMA). [Internet]. Victoria, BC: Government of British Columbia. Available from: *https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/03053_00*.

[34] BC Ministry of Environment and Climate Change Strategy. Information note – emergency application for liquid manure. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; 2021 Dec 3.

[35] BC Centre for Disease Control Public Health Laboratory. Ensuring continuity of bacteriological water quality testing during provincial emergencies [PowerPoint presentation by C Tchao]; 2022 Sep 23.

[36] BC Centre for Disease Control Public Health Laboratory. BCCDC PHL private well sampling data 2021 to 2022. Response to request for update regarding sampling of private well drinking water for flood recovery and response [email from C Tchao]; 2022 Feb 17.

[37] Edwards, J. Drinking Water Leadership Council presentation on lessons learned from private well sampling; 2022 March.

[38] BC Centre for Disease Control Public Health Laboratory. Briefing note for BC state of emergency; 2022 Nov 23.

[39] Gillett, N., Cannon, A., Malinina, E., Schnorbus, M., Anslow, F., Sun, Q., Kirchmeier-Young, M., Zwiers, F., Seiler, C., Zhang, X., Flato, G., Wan, H., Li, G and Castellan, A. Human influence on the 2021 British Columbia floods. Weather and Climate Extremes. 2022; vol 36. Doi: *https://doi.org/10.1016/j.wace.2022.100441*.

[40] Yumagulova L. Recovering from the worst BC flooding in modern history: a story of teamwork and cooperation. HazNet: The Magazine of the Canadian Risk and Hazards Network; 2019. [Internet]. Available from: *http://haznet.ca/recovering-worst-bc-flooding-modern-history-story-teamwork-cooperation/*.

[41] Yamada, C. Interior Health Authority. Personal communication; 2023 Jun 26.

[42] Emergency Management BC. 2017 freshet and wildfires: provincial after-action review. [Internet]. Province of British Columbia: Emergency Management BC; 2018. Available from: *https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/provincial-emergency-planning/embc_after_action_review_report_2017.pdf*.

[43] BC Ministry of Forests. From flood risk to resilience in B.C.: intentions paper. [Internet]. Victoria, BC: BC Ministry of Forests; 2022. Available from: *https://engage.gov.bc.ca/app/uploads/sites/797/2022/10/From-Flood-Risk-to-Resilience-in-B.C.pdf*.

[44] Government of Canada. Canada's top 10 weather stories of 2017. [Internet]. Government of Canada; [cited 2023 Jan 30]. Available from: *https://www.canada.ca/en/environment-climate-change/services/top-ten-weather-stories/2017.html*.

[45] Government of Canada. Berry, P., & Schnitter, R. (Eds.). (2022). Health of Canadians in a changing climate: advancing our knowledge for action. [Internet]. Ottawa, ON: Government of Canada; [cited 2023 Jan 30]. Available from: *https://doi.org/10.4095/329522*.

[46] British Columbia Coroners Service. Extreme heat and human mortality: a review of heat-related deaths in B.C. in summer 2021. British Columbia Coroners Service; 2022 Jun [cited 2023, Jul 31]. [Internet]. Available from: *https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/death-review-panel/extreme_heat_death_review_panel_report.pdf*.

[47] Government of Canada. Canada's top 10 weather stories of 2022. Government of Canada; [cited 2023 Jan 30]. [Internet]. Available from: *https://www.canada.ca/en/environment-climate-change/services/top-ten-weather-stories/2022.html*.

[48] Natural Resources Canada. Canada's changing climate report. [Internet]. Ottawa, ON: Government of Canada; 2019. Available from: *https://changingclimate.ca/site/assets/uploads/sites/2/2020/06/CCCR_FULLREPORT-EN-FINAL.pdf*.

[49] Government of British Columbia. Ministry of Environment and Climate Change Strategy (2019). Preliminary strategic climate risk assessment for British Columbia. [Internet]. Victoria, BC: Government of British Columbia; [cited 2021 Jan 30]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/climate-change/adaptation/prelim-strat-climate-risk-assessment.pdf*.

[50] US Environmental Protection Agency. Summary of cyanotoxins treatment in drinking water. [Internet]. US Environmental Protection Agency; 2022 Nov [cited 2023, May 11]. Available from: *https://www.epa.gov/ground-water-and-drinking-water/summary-cyanotoxins-treatment-drinking-water*.

[51] O'Keefe, J. Cyanobacteria and drinking water - occurrence risks management and knowledge gaps for public health. [Internet]. Vancouver, BC: National Collaborating Centre for Environmental Health; 2019 Mar [cited 2023 Jan 31]. Available from: *https://ncceh.ca/sites/default/files/Cyanobacteria%20and%20Drinking%20Water-%20Occurrence%20Risks%20Management%20and%20Knowledge%20Gaps%20for%20Public%20Health%20EN.pdf*.

[52] Sowa, S. Island Health. Personal communication; 2023 May 09.

[53] Sowa, S. Island Health. Personal communication; 2023 Nov 22.

[54] North Salt Spring Waterworks District. Drinking Water Quality Report, 2016. [Internet]. [cited 2023]. Available from: *https://northsaltspringwaterworks.ca/wp-content/uploads/2018/03/2016-NSSWD-Annual-Drinking-Water-Quality-Report.pdf*.

[55] Norlin, I. Interior Health. Personal communication; 2023 May 17.

[56] BC Ministry of Heath. Drinking water officers' guide - consolidated version, March 23, 2023. [Internet]. Victoria, BC: BC Ministry of Health; [cited 2023 Apr 12]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/drinking_water_officers_guide_-_consolidated.pdf*.

[57] National Collaborating Centre for Environmental Health. Cyanobacteria and drinking water: occurrence, risks, management and knowledge gaps for public health: executive summary. [Internet]. 2019 Mar [cited 2023 Jan 30]. Available from: *https://ncceh.ca/sites/default/files/Summary%20Cyanobacteria%20and%20Drinking%20Water%20EN.pdf*.

[58] Shafiei Shiva J, Chandler DG. Assessing impacts of heatwaves on urban water distribution systems: planning for a resilient design approach. In AGU Fall Meeting Abstracts 2020 Dec (Vol. 2020, pp. GC056-0013).

[59] City of Salmon Arm. Water Quality Report 2021. City of Salmon Arm, BC. [Internet]. [cited 2023 May 25]. Available from: *https://www.salmonarm.ca/DocumentCenter/View/3731/Water-Quality-Annual-Report--2021*.

[60] City of Salmon Arm. Community Water Conservation Plan. City of Salmon Arm, BC. [Internet]. [cited 2023 May 25]. Available from: *https://www.salmonarm.ca/DocumentCenter/View/4069/Water-Conservation-Plan-Final*.

[61] Resort Municipality of Whistler. Annual drinking water report 2021. Resort Municipality of Whistler, BC. [Internet]. [cited 2023 May 25]. Available from: *https://www.whistler.ca/wp-content/uploads/2023/01/2021-Annual-Drinking-Water-Report.pdf*.

[62] Glover, D. Vancouver Coastal Health. Personal communication; 2023 May 11.

[63] Capital Regional District. Greater Victoria drinking water quality: 2021 annual report. [Internet]. Victoria, BC: Capital Regional District; 2022 May [cited 2023 Jun 07]. Available from: *https://www.crd.bc.ca/docs/default-source/crd-document-library/plans-reports/drinking-water/2021-greater-victoria-drinking-water-quality-annual-report.pdf?sfvrsn=8aadfcd_4*.

[64] Wilson, K. Personal communication. Capital Regional District; 2023 Jun 07.

[65] Peninsula and Area Agricultural Commission. Peninsula & Area Agricultural Commission – 2021 annual report. [Internet]. North Saanich, BC; Peninsula and Area Agricultural Commission: 2022 Mar [cited 2023 Jun 07]. Available from: *https://northsaanich.ca/wp-content/uploads/2021-PAAC-Annual-Report.pdf*.

[66] BC Ministry of Environment and Climate Change Strategy. Response to request for data in support of the PHO Report [email from J Mack]; 2022 Mar 22.

[67] BC Ministry of Agriculture and Food. Response to request for data in support of the PHO Report [email from D Poon]; 2022 May 18.

[68] BC Ministry of Agriculture and Food. Response to request for data in support of the PHO Report [email from D Poon]; 2022 May 18.

[69] Rekken, G. Personal communication. BC Ministry of Agriculture and Food. 2023 Aug 17.

[70] Wang D., Chen Y., Jarin M. et al. Increasingly frequent extreme weather events urge the development of point-of-use water treatment systems. npj Clean Water 5, 36 (2022). *https://doi.org/10.1038/s41545-022-00182-1*.

[71] Government of Canada. Daily data report for December 2022. Prince Rupert British Columbia. [Internet]. Ottawa, ON: Government of Canada; [cited 2023 May 25]. Available from: *https://climate.weather.gc.ca/climate_data/daily_data_e.html?StationID=48693&timeframe=2&StartYear=1840&EndYear=2023&Day=24&Year=2022&Month=12#*.

[72] Extreme Weather Watch. Prince Rupert record low by day of the year. [Internet]. [cited 2023 May 25]. Available from: *https://www.extremeweatherwatch.com/cities/prince-rupert/record-low-by-day*.

[73] Duty Officer. Ministry of Health. Personal communication; 2022 Dec 17.

[74] CBC News. Prince Rupert declares local state of emergency over water main breaks, supply interruptions. Canadian Broadcasting Corporation [Internet]. 2022 Dec 18 [cited 2023 Mar 15]. Available from: *https://www.cbc.ca/news/canada/british-columbia/prince-rupert-water-supply-state-of-emergency-1.6690426*.

[75] Millar, K. City of Prince Rupert State of Emergency in effect until at least Dec. 23. The Northern View [Internet]. 2022 Dec 19 [cited 2023 Mar 15].
Available from: *https://www.thenorthernview.com/news/city-of-prince-rupert-state-of-emergency-in-effect-until-at-least-dec-23-5997621*.

[76] City of Prince Report. City of Prince Rupert annual drinking water report 2022. Prince Rupert, BC: City of Prince Rupert; [cited 2023 Nov 23].
Available from: *https://www.princerupert.ca/sites/7/files/2023-06/2023-02-28%20Annual%20Water%20Report_DRAFT%20to%20NH.pdf*.

[77] BC Ministry of Environment. Indicators of climate change for British Columbia: 2016 update. [Internet]. Victoria, BC: BC Ministry of Environment; 2016.
Available from: *https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/climate-change/climatechangeindicators-13sept2016_final.pdf*.

[78] Government of British Columbia. British Columbia drought information portal. [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 Jan 27]. Available from: *https://governmentofbc.maps.arcgis.com/apps/MapSeries/index.html?appid=838d533d8062411c820eef50b08f7ebc*.

[79] Government of Canada. Canada's top 10 weather stories of 2022. [Internet]. Ottawa, ON: Government of Canada; [cited 2023 Jan 30]. Available from: *https://www.canada.ca/en/environment-climate-change/services/top-ten-weather-stories/2022.html*.

[80] Ospan, A. Personal communication. Ministry of Health; 2023 Aug 2.

[81] Government of the United States. Drought.gov: national integrated drought information system. [Internet]. Boulder, CO: Government of the United States; [cited 2023 Feb 1]. Available from: *https://www.drought.gov/sectors/water-utilities*.

[82] Government of Canada. Berry, P., & Schnitter, R. (Eds.). (2022). Health of Canadians in a changing climate: advancing our knowledge for action. [Internet]. Ottawa, ON: Government of Canada; [cited 2023 Jan 30]. Available from: *https://doi.org/10.4095/329522*.

[83] Government of British Columbia. British Columbia drought and water scarcity response plan. [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 Jan 25]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/drought-info/drought_response_plan_final.pdf*.

[84] US Environmental Protection Agency. Drought response and recovery: a basic guide for water utilities. [Internet]. Washington, DC: US Environmental Protection Agency; 2017 Oct [cited 2023 May 9]. Available from: *https://www.epa.gov/sites/default/files/2017-10/documents/drought_guide_final_508compliant_october2017.pdf*.

[85] Galt, J. BC Ministry of Health. Personal communication; 2022 Oct 07.

[86] Government of British Columbia. Inter Agency Drought Working Group meeting minutes 2022 Oct 11.

[87] Government of British Columbia. Inter Agency Drought Working Group meeting minutes 2022 Oct 19.

[88] Meeks, K. Emergency Management BC. Personal communication; 2022 Oct 12.

[89] Larsen, K. State of emergency declared on B.C.'s Sunshine Coast because of drought. Canadian Broadcasting Corporation [Internet]. 2022 Oct 18 [cited 2023 Nov 23]. Available from: *https://www.cbc.ca/news/canada/british-columbia/sunshine-coast-state-of-emergency-1.6619595*.

[90] Grant, J. B.C. drought recovery will take time, even with rain in the forecast, forecasters say. [Internet]. CBC News. 2022 Oct 18 [cited 2023 Jan 23]. Available from: *https://www.cbc.ca/news/canada/british-columbia/bc-needs-hundred-of-millimetres-of-rain-to-recover-from-drought-1.6621152*.

[91] Wood, S. Sunshine Coast's drought emergency: 9 solutions for the future. Narwhal. 2022 Oct 21 [cited 2023 Jan 23]. Available from: *https://thenarwhal.ca/bc-drought-sunshine-coast-2022/*.

[92] Government of British Columbia. Inter Agency Drought Working Group meeting minutes 2022 Nov 23.

[93] The Canadian Press. Drought emergency lifted in B.C.'s Sunshine Coast. Global News [Internet]. 2022 Nov 18 [cited 2023 Nov 23]. Available from: *https://globalnews.ca/news/9291546/drought-emergency-lifted-in-b-c-s-sunshine-coast/*.

[94] Jordison, C. Stage 4 water restrictions finally lift on the Sunshine Coast. Coast Reporter [Internet]. 2022 Dec 13 [cited 2023 Nov 23]. Available from: *https://www.coastreporter.net/local-news/stage-4-water-restrictions-finally-lift-on-the-sunshine-coast-6241450*.

[95] Muirhead, P. Vancouver Coastal Health. Personal communication; 2022 Oct 18.

[96] Pickles, J. Vancouver Coastal Health. Personal communications; 2023 Nov 28.

[97] Quibell, D. Northern Health Authority. Personal communication; 2022 Oct 25.

[98] BC Ministry of Water, Land and Resource Stewardship. British Columbia drought and water scarcity response plan. [Internet]. 2023 Apr. Victoria, BC: BC Ministry of Water, Land and Resource Stewardship; [cited 2023 Jan 25]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/drought-info/drought_response_plan_final.pdf*.

[99] Government of British Columbia. Drought information. [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 Jan 25]. Available from: *https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/drought-flooding-dikes-dams/drought-information*.

[100] Government of British Columbia. Dealing with drought: a handbook for water suppliers in British Columbia. [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 Dec 4]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/drought-info/dealing_with_drought_handbook.pdf*.

[101] ICF. Preliminary strategic climate risk assessment for British Columbia – summary of results [prepared for the BC Ministry of Environment and Climate Change Strategy]. [Internet]. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; 2019 Jul. Available from: *https://www2.gov.bc.ca/assets/gov/environment/climate-change/adaptation/climate-risk-summary.pdf*.

[102] CleanBC. Wildfires. Victoria, BC: CleanBC; [cited 2023 Apr 12]. Available from: *https://cleanbc.gov.bc.ca/about-climate-change/impacts/wildfires/#frequent*.

[103] HealthLink BC. Wildfire: its effects on drinking water quality [HealthLink BC File #49f]. [Internet]. Victoria, BC: HealthLink BC; 2021 May. Available from: *https://www.healthlinkbc.ca/healthlinkbc-files/wildfire-its-effects-drinking-water-quality*.

[104] McVea. D. Personal communication. Provincial Health Services Authority. BC Centre for Disease Control Public Health Laboratory; 2023 Aug 03.

[105] Ospan, S. Personal communication. BC Ministry of Health; 2023 Aug 02.

[106] Isaacson K, Proctor C, Wang E, Edwards E, Noh Y, Shah A, Whelton A. Drinking water contamination from the thermal degradation of plastics: implications for wildfire and structure fire response. Royal Society of Chemistry. Environmental Science: Water Research & Technology. 2021; 7; 274-284. Available from: *https://pubs.rsc.org/en/content/articlehtml/2021/ew/d0ew00836b*.

[107] US Environmental Protection Agency. Ground Water and Drinking Water. National Primary Drinking Water Regulations. US Environmental Protection Agency; [cited 2023 Nov 22]. Available from: *https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations#Organic*.

[108] Government of Canada. Guidelines for Canadian drinking water quality – summary tables. [Internet]. Ottawa, ON: Government of Canada; 2022 Sep [cited 2023 Nov 22]. Available from: *https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html*.

[109] BC Ministry of Environment. Indicators of climate change for British Columbia: 2016 update. [Internet]. Victoria, BC: BC Ministry of Environment; 2016. Available from: *https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/climate-change/climatechangeindicators-13sept2016_final.pdf*.

[110] Interior Health Authority. Evacuation orders and alerts [email from I Norlin]; 2023 Feb 17.

[111] Interior Health Authority. Evacuation orders and alerts update [email from I Norlin]; 2023 Mar 02.

[112] Village of Lytton. Short-term recovery plan – draft. [Internet]. Lytton, BC: Village of Lytton; 2021. Available from: *https://lytton.ca/wp-content/uploads/2021/10/DRAFT_2021-10-27_Village-of-Lytton_Short-Term-Recovery-Plan_Final.pdf*.

[113] BC Wildfire Service. British Columbia FireSmart. An examination of the Lytton, British Columbia wildland-urban fire destruction. Summary Report to the British Columbia FireSmart Committee; [cited 2023 Dec 04]. Available from: *https://firesmartbc.ca/wp-content/uploads/2022/05/An-examination-of-the-Lytton-BC-wildland-urban-fire-destruction.pdf*.

[114] Tesic-Nagalignham D. Personal communication. Interior Health Authority; 2023 Apr 11.

[115] Emergency Management BC. Central Provincial Regional Emergency Operations Centre (CTL PREOC) situation report 7 [email from R Epp]; 2022 Jul 21.

[116] First Nations Health Authority. Drinking water at Lytton FN [email from D Ferguson]; 2022 Jul 18.

[117] BC Wildfire Service. 2021 wildfire season summary. [Internet]. Available from: *https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary*.

[118] Regional District of North Okanagan. Evacuation order remains in place due to White Rock Lake fire. [Internet]. Available from: *https://www.rdno.ca/our-communities/rdno-news/evacuation-order-remains-place-due-white-rock-lake-fire*.

[119] Regional District of Central Okanagan. White Rock Lake Wildfire community recovery. Available from: *https://www.rdco.com/en/living-here/white-rock-lake-wildfire-community-recovery.aspx*.

[120] Interior Health Authority. SBAR – wildfire damage to Killiney Beach water supply system [email from I Norlin]; 2021 Sep 21.

[121] Interior Health Authority. DNC rescinded for Killiney Beach Water Supply System on Westside Road NX2021-121209 [email from J Ekkert]; 2021 Nov 12.

[122] Interior Health Authority. Wildfire letter to MOH. Interior Health Authority; 2021 Dec 3.

[123] Norlin J.I., Olivares D, Mema S. Climate change and drinking water: exploring resilience to wildfire in the BC Southern Interior. 2023. [Manuscript submitted for publication].

[124] BC Wildfire Service. Community Resiliency Investment Program. [Internet]. Victoria, BC: BC Wildfire Service; [cited 2023 Apr 12]. Available from: *https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/funding-for-wildfire-prevention/crip*.

[125] BC Wildfire Service. Cultural and prescribed fire. Victoria, BC: BC Wildfire Service; [cited 2023 Apr 12]. Available from: *https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/vegetation-and-fuel-management/prescribed-burning*.

[126] BC Ministry of Forests. Forest landscape plans. [Internet]. Victoria, BC: BC Ministry of Forests; [cited 2023 Apr 12]. Available from: *https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-landscape-plans*.

[127] BC Ministry of Environment and Climate Change Strategy. How BC is preparing for climate change. [Internet]. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; [cited 2023 Apr 12]. Available from: *https://www2.gov.bc.ca/gov/content/environment/climate-change/adaptation/preparing-actions*.

[128] BC Wildfire Service. British Columbia FireSmart. FireSmart Begins at Home Manual. Victoria, BC: BC Wildfire Service; [cited 2023 Nov 22]. Available from: *https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/wildfire-status/prevention/prevention-home-community/bcws_homeowner_firesmart_manual.pdf*.

[129] Climate Change Adaptation Program. Wildfire [Internet]. Available from: *https://www.bcclimatechangeadaptation.ca/issues/wildfire/*.

[130] Schnitter, R. BC Ministry of Health. Personal communication; 2023 Mar 29.

[131] Secwépemc Restoration and Stewardship Society. Elephant Hill: Secwépemc leadership and lessons learned. [Internet]. Kamloops, BC: Secwépemc Restoration and Stewardship Society; [cited 2023 May 25]. Available from: *https://www.srssociety.com/lessonslearned.htm*.

[132] Government of British Columbia. A report for government and British Columbians. Addressing the new normal: 21st century disaster management in British Columbia. Report and findings of the BC Flood and Wildfire Review: an independent review examining the 2017 flood and wildfire seasons. [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 May 25]. Available from: *https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/bc-flood-and-wildfire-review-addressing-the-new-normal-21st-century-disaster-management-in-bc-web.pdf*.

[133] Owen B. "Almost complete loss" of early salmon runs at Fraser River slide last year: DFO. [Internet]. CBC News. 2020 Jun 20 [cited 2023 May 25]. Available from: *https://www.cbc.ca/news/canada/british-columbia/big-bar-landslide-salmon-run-almost-complete-loss-1.5605907*.

Clean, Safe, and Reliable Drinking Water

An Update on Drinking Water Protection in BC and the *Action Plan for Safe Drinking Water in British Columbia*

BRITISH COLUMBIA | Office of the Provincial Health Officer

Provincial Health Officer's Drinking Water Report: 2012/13-2016/17

PART 6:

Progress Report on 2019 Recommendations

Part 6 (Chapter 11) provides an update on the 32 recommendations provided in the Provincial Health Officer's 2019 report *Clean, Safe, and Reliable Drinking Water: An Update on Drinking Water Protection in BC and the Action Plan for Safe Drinking Water in British Columbia*, which covered fiscal years 2012/13 through 2016/17. Chapter 11 discusses the actions taken from April 1, 2017 to March 31, 2022 to address each recommendation, and includes a status update (completed, in progress, ongoing, or no action taken).

CHAPTER

11

Progress Report on 2019 Recommendations

11.1 Recommendations Overview

The Provincial Health Officer (PHO) is required to report annually on activities under the *Drinking Water Protection Act*.[1] The PHO has released five such reports since the Act was enacted in 2003. The last report, *Clean, Safe, and Reliable Drinking Water: An Update on Drinking Water Protection in BC and the Action Plan for Safe Drinking Water in British Columbia*,[2] released in 2019, covered fiscal years 2012/13 through 2016/17 and included 32 recommendations:

- Recommendations 1 through 3 were priority recommendations for the provincial government and pertained to the overall governance of drinking water.
- Recommendations 4 through 7 provided actions for improving legislative and policy frameworks to protect drinking water.
- Recommendation 8 referred to improving available data to strengthen program oversight and evaluation.
- Recommendations 9 through 12 presented options for creating a strengthened strategic approach to improving small water system governance and sustainability.
- Recommendations 13 through 32 outlined actions for addressing specific areas of challenge with the multi-barrier approach to drinking water protection, which were highlighted within this report.

Lead agencies for each recommendation or group of recommendations were identified. While some recommendations clearly had a provincial ministry[a] or agency lead, others required co-leadership and/or cross-ministry and cross-agency partnerships. Since the release of the 2019 PHO report, the Province has undergone a significant restructuring of the natural resource ministries with the creation of the Ministry of Water, Land and Resource Stewardship (WLRS) in 2022. As a result of the reorganization of responsibilities, the lead agencies for many of the recommendations that have not been completed have changed.

The Province and the regional health authorities have made notable progress in advancing many of the 32 recommendations in the 2019 PHO report. Six recommendations have been completed, implementation of 14 recommendations is in progress, and action on five recommendations is ongoing. However, no action has been taken on seven recommendations. Delays in progress on addressing these recommendations are due largely to staffing shortages and capacity issues resulting from the COVID-19 pandemic response, ongoing job vacancies, and increased work loads in response to natural disasters, competing program demands, and the transition of responsibilities and leadership within the natural resource ministries due to the creation of WLRS.

[a] During the reporting period, the following ministries changed names:
- Ministry of Agriculture and Food (formerly the Ministry of Agriculture)
- Ministry of Energy, Mines and Low Carbon Innovation (formerly the Ministry of Energy, Mines and Petroleum Resources)
- Ministry of Forests (formerly the Ministry of Forests, Lands, Natural Resource Operations and Rural Development)
- Ministry of Water, Land and Resource Stewardship (formerly the Ministry of Land, Water and Resource Sustainability)
- Ministry of Municipal Affairs (formerly the Ministry of Municipal Affairs and Housing)
- BC Energy Regulator (formerly the BC Oil and Gas Commission)

This report refers to each ministry using its new name. On October 19, 2023, after completion of this report, responsibility for the administration of water, land, fish, and wildlife was transferred from the Ministry of Forests (FOR) to the Ministry of Water, Land and Resource Stewardship. This transfer included the Water Management Branch and the Comptroller of Water Rights, which are referred to as being part of FOR throughout this report.

This chapter includes a recommendations report card, which gives a snapshot of each recommendation's status.

Recommendation Status Definitions

Completed	Actions have been taken, and the recommendation has been followed.
In Progress	Actions have been taken but have not been completed.
Ongoing*	Activities are conducted regularly to meet agency business requirements.
No Action Taken	No action has been taken to address the recommendation.

* Recommendations identified as "ongoing" provide advice and will not be carried forward as future recommendations.

The report card is followed by discussions of the actions taken by the PHO, Ministry of Health (HLTH), the regional health authorities, Ministry of Forests (FOR), Ministry of Environment and Climate Change Strategy (ENV), and other agencies to address the recommendations. This chapter covers the fiscal years, 2017/2018–2021/2022, prior to the government reorganization in 2022; as a result, the leads listed for each recommendation reflect the agencies that were assigned to the recommendation prior to the reorganization. Any recommendations carried forward in Chapter 12 list the new lead based on current mandates.

11.2 Recommendations Progress Report Card

Progress Report Card

Recommendation	Status
1. *Governance of Drinking Water Protection* Review the existing governance structure of drinking water protection to ensure clear lines of responsibility and accountability are defined.	Completed
2. *Action Plan and Memorandum of Understanding* Revisit and update the *Action Plan for Safe Drinking Water in British Columbia* and the 2006 Memorandum of Understanding regarding inter-agency accountability and coordination on drinking water protection, and recommit to modernized principles and actions across government.	In progress
3. *Inter-agency Collaboration and Coordination* Identify a new framework for inter-agency collaboration and coordination that aligns with current structures and issues.	Completed
4. *Legislative Framework Review* Evaluate the available legislative tools to protect sources of drinking water under the *Drinking Water Protection Act* and other acts to identify any gaps, areas of overlap or conflict, and triggers for enforcement action. Establish improved processes for coordinating actions taken to compel compliance to protect drinking water. The evaluation should include a review of the tools available under the *Drinking Water Protection Act, Public Health Act, Water Sustainability Act, Environmental Management Act,* and *Forest and Range Practices Act.*	Completed
5. *Drinking Water Protection Plans* Review the objectives and effectiveness of drinking water protection plans under the *Drinking Water Protection Act* as a source protection tool to determine if changes to the Act could enable more collaborative and proactive source protection that would be legally binding.	In progress
6. *Regulatory Conflict with the Water Sustainability Act* Collaborate on policy options to address regulatory conflicts between the *Drinking Water Protection Act* and the *Water Sustainability Act* regarding protecting sensitive aquatic environments under the *Water Sustainability Act* through the construction of joint intake waterworks and preventing the creation of new small water systems under the *Drinking Water Protection Act*.	No action taken

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Recommendation	Status
7. *Public Assent Processes and the Community Charter* Review the waiver of public assent for borrowing processes related to the installation of treatment works for local government drinking water systems under the Municipal Liabilities Regulation in the *Community Charter*. Identify an alternate strategy to remove barriers to borrowing for necessary infrastructure improvements while also providing a streamlined opportunity for public assent. As part of this review, consider the liquid/solid waste management plans under the *Environmental Management Act* as a model.	No action taken
8a. *Requirements for Reporting by the Office of the Provincial Health Officer* Continue to adapt health authority data systems to align with the new indicators and water system categories developed collaboratively by the Office of the Provincial Health Officer, the regional health authorities, and the Ministry of Health, and be able to report out on such data within five years of the publication of this report.	In progress
8b. *Provincial Information Management and Information Technology Strategy* Develop a provincial strategy to ensure data collected are relevant, reliable, consistent, and accessible and which build on the indicators and water system categories developed collaboratively by the Office of the Provincial Health Officer, the regional health authorities, and the Ministry of Health.	In progress
9. *Small Water System Strategy* Recommit to an oversight body to develop a small water system strategy to (1) prevent the development of new unsustainable small water systems during subdivision development; (2) promote amalgamation and acquisition of small water systems; and (3) build capacity and sustainability of existing small water systems.	In progress
10. *Amalgamation, Acquisition, and Conversion* 10a. Develop and resource a strategic approach to encourage and facilitate the conversion of improvement districts, using established best practices. 10b. Develop best practices and guidance for local government for the development and implementation of an acquisition and amalgamation plan for small water systems. 10c. Identify resources required to develop dedicated funding to a) assist and provide incentive to local governments in the amalgamation or acquisition of small water systems; and b) support the conversion of improvement districts.	No action taken
11. *Utilities and the Escheat Act* Identify a strategy to ensure that customers of private water utilities that have fallen into escheat are provided with well-managed, safe, and reliable drinking water as quickly as possible.	No action taken
12. *Water Users' Communities* Identify opportunities for greater collaboration on the approval and oversight of water users' communities, in order to improve capacity, accountability, and sustainability.	No action taken
13. *Source and System Assessment* Develop a work plan to ensure that all water suppliers have a source and system assessment on record that identifies potential risks and vulnerabilities; this assessment can then be used to develop a response plan for source and system protection.	Ongoing
14. *Treatment Objectives* Develop a process to uniformly review water systems to identify which systems do not meet the BC surface or groundwater treatment objectives. This review will inform the development of financial plans and compliance processes to meet the treatment objectives and will help identify where resources are best directed to achieve identified target dates for improvements.	In progress
15. *Design and Performance Standards* Develop provincial guidance for a) the assignment of log-reduction credits for the evaluation of treatment processes against treatment objectives; and b) the design of waterworks.	Completed
16. *Distributuion System Integrity and Maintenance* Develop provincial guidance for drinking water officers for the review and assessment of distribution integrity, management, and maintenance that considers the varying sizes, capacities, and complexities of water systems.	In progress
17. *Secondary Disinfection* Systematically review all water systems to identify which systems do not provide secondary disinfection, and of those, which systems will require secondary disinfection as per the *British Columbia Guidelines (Microbiological) on Maintaining Water Quality in Distribution Systems*. Continue to promote secondary disinfection for all drinking water systems as best practice.	Ongoing
18. *Cross-connection Control* Ensure water supply systems have appropriate plans/procedures in place to proactively identify and address cross-connections. Encourage all local government water purveyors to have an enforceable cross-connection control program.	Ongoing

Recommendation	Status
19a. *Lead in Drinking Water: Schools* Establish a consistent sampling and reporting protocol for lead in drinking water for schools to follow. Continue to develop plans to implement measures to effectively reduce lead in school drinking water.	Completed
19b. *Lead in Drinking Water: Child Care Facilities* Develop plans to promote screening for, and implement measures to effectively reduce levels of, lead in the drinking water of child care facilities, recognizing that children under the age of six are the most vulnerable to the harmful effects of lead.	Completed
20. *Bulk Water Haulers* Develop provincial guidelines for bulk water haulers to reflect current regulatory requirements and best practices.	No action taken
21. *Operator Certification* Ensure that a satisfactory information exchange is occurring between the regional health authorities and the Environmental Operators Certification Program to identify water suppliers who are out of compliance with operator certification requirements.	Completed
22. *Operator Training* Develop a minimum recommended standard of training and competencies for a small water system operator and bulk water haulers. Standards for small water systems should take into account the varying sizes, levels of complexity, water sources, and governance structures of these small systems.	No action taken
23. *Emergency Response* Ensure all water systems have an appropriate emergency response and contingency plan and have the necessary training and capacity to implement it when needed.	Ongoing
24. *Asset Management and Financial Planning* Review training needs and develop guidance for drinking water officers on the required elements of an asset management plan and financial plans for different types of water systems.	In progress
25. *Water Chemistry Data* Develop and resource an action plan and strategy to make water chemistry data for water supply systems from private laboratories available online for reporting and evaluation purposes.	In progress
26. *Water Quality Data Sharing* Identify effective ways to share water quality monitoring data across agencies with responsibilities in source water protection.	In progress
27. *Access to Approved Laboratories* Develop a strategic approach to support improved access to water testing in remote and rural areas. This includes exploring Level C laboratories and point-of-use testing for microbiological indicators.	In progress
28. *Boil Water Notices* Continue efforts to identify water systems that are on chronic, long-term boil water notices for reasons such as inadequate infrastructure and management, to inform a strategic long-term action plan to support improvements to these systems.	Ongoing
29. *Drinking Water Program Resource Requirements* Review the resources needed by the Ministry of Health, Office of the Provincial Health Officer, and the regional health authorities to effectively fulfil their roles under the *Drinking Water Protection Act*.	In progress
30. *Training Needs of Persons Acting as Drinking Water Officers* Review the training needs of individuals who are acting as drinking water officers in BC, to allow them to carry out program responsibilities under the *Drinking Water Protection Act* and to effectively support water suppliers to achieve clean, safe, and reliable drinking water through the multi-barrier approach.	In progress
31. *Investigating Threats to Drinking Water* Develop guidance for investigating threats to drinking water under section 29 of the *Drinking Water Protection Act*. These guidelines should clarify the scope of section 29 investigations where assessments are required outside of the capacity of the health authority.	In progress
32. *Tracking of Activities under the Drinking Water Protection Act* Develop a consistent and reliable method for tracking drinking water program activities under the *Drinking Water Protection Act*, including inspections, investigations, enforcement actions, reconsideration of decisions, and drinking water officer engagement and interactions with water suppliers, operators, local governments, and the public.	In progress

11.3 Detailed Recommendations Progress Report

11.3.1 Governance of Drinking Water Protection

The 2019 PHO drinking water report highlighted challenges pertaining to the governance of drinking water protection that have evolved since the 2002 release of the *Action Plan for Safe Drinking Water in British Columbia*.[3] The governance of drinking water and source water supplies in BC is complex and involves many actors federally, provincially, and locally. The decentralized nature of the regulatory structure in BC has led to challenges when competing interests arise, particularly for source water protection. The Action Plan called for coordination of resources to ensure there are clear lines of responsibility within government for various aspects of drinking water protection, source protection, land use planning, and infrastructure. However, the interagency group tasked with facilitating that coordination and implementing the Action Plan (i.e., the Assistant Deputy Ministers' Committee on Water) has disbanded, and the signatory ministries of the Action Plan and the 2006 Memorandum of Understanding regarding interagency accountability and coordination on drinking water protection have changed, as have their portfolios, program responsibilities, and strategic priorities. As a result, there was no clarity on roles and responsibilities for source water protection, or an interagency committee with the mandate to coordinate the protection of drinking water until 2022 when the new Ministry of Water, Land and Resources Stewardship was formed.

Recommendations 1 through 3 in the 2019 PHO report called for actions to improve the governance of drinking water protection. Shortly after the release of that report, the BC Office of the Auditor General (OAG) made similar recommendations in its 2019 report *The Protection of Drinking Water*.[4] The OAG recommendations called for a review of legislation, the development of a strategic plan for the protection of drinking water, and the establishment of clear roles, responsibilities, and accountabilities for all government agencies that are responsible for ensuring the provision of safe drinking water.

Since the release of both reports, the Province has made progress in advancing the governance of drinking water protection, as outlined next.

Recommendation 1: Governance of Drinking Water Protection

Review the existing governance structure of drinking water protection to ensure clear lines of responsibility and accountability are defined.

Leads: *Ministry of Health, Ministry of Environment and Climate Change Strategy*

Progress and Next Steps

This recommendation is **complete.**

In 2022, the leads for this recommendation changed due to the creation of WLRS. The following describes actions taken by the initial leads during the reporting period prior to the government reorganization in 2022.

Both the 2019 PHO and OAG reports assigned HLTH the responsibility of clarifying the roles, responsibilities, and governance of drinking water protection, particularly source water protection, which was shared across several ministries. In response, in February 2020, HLTH engaged the deputy ministers of partner ministries to seek direction and commitment to support HLTH's action plan in response to the recommendations from the OAG pertaining to the governance of drinking water; priority actions included a legislative review and clarification of roles and responsibilities for source water protection. In 2021, HLTH completed a legislative review of source water protection in BC (described on the following page) with support from the deputy ministers and an Executive Directors Steering Committee for Drinking Water. In discussion with members of the committee, HLTH developed a proposed governance model for source water protection and recommended that a natural resource sector ministry with the appropriate mandate take on the lead for source water protection.

In 2022, the Province formed the new Ministry of Land, Water and Resource Stewardship (now the Ministry of Water, Land and Resource Stewardship) to act as the principal agency in providing leadership on water policy and strategies, including the coordination of the government's Source-to-Tap Strategy to protect drinking water.

Other aspects of the drinking water program, such as the regulation and governance of small water systems, have yet to be reviewed (see Recommendation 9 and 10 for a status update on small water systems).

The following provides additional information on activities undertaken by government in response to this recommendation.

Legislative Review

In 2020, HLTH retained Econics to undertake a legislative review of all statutes and regulations that apply to water protection to identify the existing governance structure of drinking water and source water protection.[5] The Econics report *Review of Source Water Protection Mandates* identified three key issues with source water protection in the province:

- There is a lack of leadership and role clarity within provincial government agencies specifically related to source water protection.
- The existing regulatory framework could better prioritize source water protection.
- There are significant operational impediments to effective protection of drinking water sources.[6]

The Econics report also included 15 recommendations and strongly encouraged government to focus on implementing the following recommendations:

1. Establish senior executive leadership through a deputy minister's committee on water management.
2. Establish operational leadership through an operational water policy committee.
3. Develop a new provincial strategic plan for drinking water management.
4. Create a Memorandum of Understanding to clarify the roles and responsibilities of agencies involved in source protection.[6]

Ministry of Water, Land and Resource Stewardship

In 2021, the Lands and Natural Resource Operations Secretariat was given the mandate to develop a plan to create a new ministry for lands and natural resource operations. The new ministry would develop and implement land use policies to support BC's goals for economic activity, environmental sustainability, and reconciliation with Indigenous Peoples. Water was identified as a key focus area for the new ministry.

On February 25, 2022, the natural resource sector deputy ministers announced plans to restructure the natural resource ministries by creating the Ministry of Land, Water and Resource Stewardship (now the Ministry of Water, Land and Resource Stewardship), effective April 1, 2022. WLRS is tasked with providing provincial leadership on water and coordinating the government's Source-to-Tap Strategy to protect drinking water. Other important water-related strategies and policies led by WLRS include (but are not limited to) the following:

- Watershed Security Strategy
- Coastal Marine Strategy and the Wild Salmon Strategy
- Marine use policy and planning
- Water sustainability planning and water quality objective setting

With WLRS providing provincial leadership on, and coordination of, the Source-to-Tap Strategy, actions to address the governance of drinking water protection have been fully implemented.

Recommendation 2: Action Plan and Memorandum of Understanding

Revisit and update the *Action Plan for Safe Drinking Water in British Columbia* and the 2006 Memorandum of Understanding regarding inter-agency accountability and coordination on drinking water protection, and recommit to modernized principles and actions across government.

Leads: *Ministry of Health, Ministry of Environment and Climate Change Strategy*

Progress and Next Steps

This recommendation is **in progress.**

In 2022, the leads for this recommendation changed due to the creation of WLRS. The following describes actions taken by the initial leads during the reporting period prior to the government reorganization in 2022.

In 2021, in response to recommendations from both the PHO and OAG, HLTH began developing a provincial strategic plan for safe drinking water to replace the 2002 *Action Plan for Safe Drinking Water in British Columbia*. At that time, HLTH identified updating the 2006 Memorandum of Understanding regarding inter-agency accountability and coordination on drinking water protection as an outcome of that work.

In April 2022, the responsibility for reviewing the roles and responsibilities of all agencies involved in ensuring the provision of safe drinking water was transferred from HLTH to the new WLRS. As a result, WLRS became the new lead for this recommendation.

The following provides additional information on activities undertaken by HLTH and ENV in response to this recommendation prior to the creation of WLRS.

Strategic Plan for Safe Drinking Water

In fall 2021, HLTH began development of a project plan for, and engagement on, a provincial strategic plan for safe drinking water in BC. The plan was meant to replace the 2002 *Action Plan for Safe Drinking Water in BC*.[5] HLTH received support to develop the strategic plan from the Executive Directors Steering Committee on Drinking Water which had representation from agencies that are responsible for ensuring the provision of safe drinking water (e.g., ENV, FOR, the Ministry of Municipal Affairs [MUNI], the Ministry of Agriculture and Food, the Ministry of Energy, Mines and Low Carbon Innovation, and the BC Energy Regulator).[5]

In late 2021, HLTH hired MNP Consulting to deliver a project charter for the development of the strategic plan. The charter and engagement plan were completed on April 30, 2022.[5] Key interested parties, partner ministries, and Indigenous partners, including the PHO, BC Centre for Disease Control, ENV, First Nations Health Authority, regional health authorities, BC First Nations Leadership Council, and BC Water and Waste Association, informed the development of the project charter.[5] With support from HLTH, leadership on, and coordination of, the Source-to-Tap Strategy plan was transferred to WLRS. Further action on this recommendation was delayed due to that transfer. Both the charter and engagement plan could be used by WLRS as it develops the provincial Watershed Security Strategy and related Source-to-Tap Strategy.[7]

Watershed Security Strategy

In winter 2021/22, ENV launched the development of the Watershed Security Strategy. It is being co-developed with First Nations and in collaboration with Indigenous Peoples, and local and federal governments. Industry and environmental non-government organizations will also contribute to the Watershed Security Strategy. It is intended to:

- Build on, align with, and complement the current work across government to help ensure BC's watersheds are healthy.
- Reflect the Province's commitment to true, lasting reconciliation and align with the United Nations Declaration on the Rights of Indigenous Peoples and the *Declaration on the Rights of Indigenous Peoples Act*, 2019.
- Explore key policy directions such as governance, climate change, ecosystems, drinking water, community and economic stability, and education and knowledge.
- Include consultation with colleagues across government to ensure it is aligned with other priorities, in particular, the coastal marine, wild salmon, and drinking water strategies, and with modernized land use planning.[8]

WLRS and the First Nations Fisheries Council also convened the BC–First Nations Water Table to support the Province and First Nations in identifying, discussing, and making consensus-based recommendations to provincial and First Nations' decision makers about matters of mutual interest. The first priority of the Water Table is to co-develop the Watershed Security Strategy.[9]

The strategy is now under the leadership of WLRS and will include linkages to the Source-to-Tap Strategy.

Agreement Regarding Interagency Accountability and Coordination

Similar to the recommendation in the 2019 PHO report to update the Action Plan and the 2006 Memorandum of Understanding regarding inter-agency accountability and coordination on drinking water, the 2019 OAG report, *The Protection of Drinking Water*, called for HLTH to "provide the leadership necessary to develop a cross-ministry commitment to coordinate strategies to address risks to drinking water. This includes establishing clear roles, responsibilities and accountabilities for all government agencies that are responsible for ensuring safe drinking water."[4]

In December 2019, in response to recommendations from the PHO and OAG, HLTH and the PHO presented a comprehensive Action Plan to the Public Accounts Committee. The Committee accepted the Action Plan, which included HLTH's commitment to clarifying

accountabilities across government through the Source-to-Tap Strategy. In 2022, the responsibility for leading that strategy (and the subsequent agreements that establish roles, responsibilities, and accountabilities of partner agencies involved in drinking water) was transferred to the new WLRS. Both HLTH and the PHO will continue to support this work. According to the 2022 update to the OAG report, in 2023, WLRS, along with HLTH and other partner ministries, plans to commence work on the Source-to-Tap Strategy and on developing agreements to establish roles and responsibilities with partner agencies involved in drinking water.

Recommendation 3:
Inter-agency Collaboration and Coordination

Identify a new framework for interagency collaboration and coordination that aligns with current structures and issues.

Leads: *Ministry of Health, Ministry of Environment and Climate Change Strategy*

Progress and Next Steps

The recommendation is **complete.**

In 2022, the leads for this recommendation changed due to the creation of WLRS. The following describes actions taken by the initial leads during the reporting period prior to the government reorganization in 2022.

Since 2019, the Province has established several executive-level committees to facilitate broader interagency collaboration and coordination regarding drinking water, including the Executive Directors Steering Committee on Drinking Water, BC Water Committee, Assistant Deputy Minister Water Forum, and Water Policy and Legislation Committee.

Between January and November 2021, HLTH established the cross-government Executive Directors Steering Committee on Drinking Water to support HLTH's response to the OAG report, and to contribute to the development of a modernized strategic plan for safe drinking water. Discussions at the Executive Directors Steering Committee on Drinking Water, BC Water Committee, and Assistant Deputy Minister Water Forum informed recommendations from HLTH to clarify roles and responsibilities related to source water protection. As a result of these recommendations from the Executive Directors Steering Committee on Drinking Water and the Lands and Natural Resource Operations Secretariat, the Assistant Deputy Minister Water Forum and BC Water Committee led by WLRS have become the new framework for interagency collaboration and coordination to align with the government's new structure and priorities, which include drinking water and reconciliation with Indigenous Peoples. *Figure 11.1* illustrates the relationships between the committees.

Figure 11.1: Water Committee Relationships

Note: ADM: assistant deputy minister; ADMCNR: Assistant Deputy Minister Committee on Natural Resources; WSSF: Watershed Security Strategy Fund. A solid line indicates a formal reporting relationship; a dashed line indicates no formal reporting relationship.

Source: BC Water Committee Terms of Reference; 2022 Jun 9.

Other interagency committees have formed to address specific topics such as the Watershed Security Strategy, Hullcar aquifer, BC Flood Strategy, and British Columbia–Washington State Nooksack River Transboundary Water Quality Task Group.

The following provides additional information on activities undertaken by HLTH, ENV, and other partner ministries in response to this recommendation.

Executive Directors Steering Committee on Drinking Water

In January 2021, HLTH established the cross-government Executive Directors Steering Committee on Drinking Water.[5] From January to November 2021, the Executive Directors Steering Committee on Drinking Water assisted in advancing recommendations outlined in the Action Plan and Progress Assessment through ongoing coordination and communication between ministries and health sector agencies. Topics covered in the Action Plan include coordination of strategies; establishment of clear roles, responsibilities, and accountabilities; and prioritization of the protection of health in regulatory decision-making.[5] ENV, FOR, MUNI, the Ministry of Energy, Mines and Low Carbon Innovation, the Ministry of Indigenous Relations and Reconciliation, the Ministry of Agriculture and Food, and the BC Energy Regulator participated in the Steering Committee.[5]

The BC Water Committee has taken on the role of the Executive Directors Steering Committee on Drinking Water, which disbanded in November 2021.[5]

BC Water Committee

The BC Water Committee, established by ENV in 2021, sets strategic direction for water management in BC and ensures the government's mandate is delivered effectively across provincial agencies. This includes providing support to work that is underway to enhance drinking water protection. Committee members include executive directors and managers from the Ministry of Agriculture and Food, ENV, WLRS, FOR, HLTH, and the Ministry of Indigenous Relations and Reconciliation. The BC Water Committee provides support to, and takes direction from, the Assistant Deputy Minister Water Forum.

The BC Water Committee's scope includes (but is not limited to):

- Developing and implementing water-related streamlining initiatives, legislation, regulation, and policy;
- Shaping recommendations to senior government on the strategic direction of the Watershed Security Strategy;
- Supporting work that is underway to enhance drinking water protection;
- Advising on the integration of *Water Sustainability Act* tools, such as water sustainability plans and water objectives, with other government resource-planning initiatives;
- Coordinating efforts on water data collection and developing water information tools;
- Advancing reconciliation by shaping the direction of water governance with Indigenous Nations;
- Engaging in discussions on an integrated cross-agency approach to watershed protection and water science; and
- Overseeing implementation of sub-committees that are focused on specific aspects of water stewardship program delivery and time-limited projects.[10]

Assistant Deputy Minister Water Forum

The Assistant Deputy Minister Water Forum, established by ENV in 2021, facilitates collaboration on provincial strategic water policies. It provides support, advice, and direction to the BC Water Committee. Forum membership aligns with that of the BC Water Committee.

Both the BC Water Committee and the Assistant Deputy Minister Water Forum provide direction to the Water Policy and Legislation Committee. Critical issues that cannot be resolved within the Water Policy and Legislation Committee are escalated to the BC Water Committee and the Assistant Deputy Minister Water Forum for resolution.[11] The Assistant Deputy Minister Water Forum does not have a formal reporting relationship to the Assistant Deputy Minister Committee on Natural Resources; however, discussions between members of the Assistant Deputy Minister Water Forum will inform and support the Assistant Deputy Minister Committee on Natural Resources' formal decision-making.[11]

Water Policy and Legislation Committee

The Water Policy and Legislation Committee is a cross-agency committee that is responsible for legislative, strategic, and operational policy, procedures, and guidance related to the delivery of the provincial water program. Committee interests include, but are not limited to, water allocation, drinking water, sector water use (e.g., agriculture, and oil and gas), the Wild Salmon Strategy, and modernized land use planning. The purpose of Water Policy and Legislation Committee is to:

- Review and endorse new and updated water-related policies;
- Provide direction on policy development, communication, and implementation;
- Provide a consistent and transparent policy development process and communications protocol;
- Ensure policy development is appropriately resourced;
- Provide corporate interpretation of policies;
- Ensure operational policy is consistent with legislation;
- Monitor for policy implementation challenges;
- Assist in prioritizing water-related policy work; and
- Coordinate policy development with program delivery.[12]

The Water Policy and Legislation Committee receives direction and endorsement from the BC Water Committee and the Assistant Deputy Minister Water Forum, and includes representation from the BC Energy Regulator, the Ministry of Agriculture and Food, the Ministry of Energy, Mines and Low Carbon Innovation, ENV, FOR, the Ministry of Indigenous Relations and Reconciliation, WLRS, and HLTH.

11.3.2 Legislative and Policy Frameworks to Protect Drinking Water

Since 2003, the *Drinking Water Protection Act* and its regulation have been the primary legislation for protecting drinking water. Other legislative developments and updates to protect water sources have included the development of the *Water Sustainability Act*, Groundwater Protection Regulation, *Forest and Range Practices Act*, and *Environmental Management Act*, among others. The 2019 PHO drinking water report demonstrated that it is necessary to review the tools available to protect drinking water under the various statues; it offered four recommendations pertaining to policy and legislation.

Since the last PHO report was issued, a legislative framework review has been completed by HLTH and ENV. FOR has updated various pieces of legislation to help protect drinking water (Recommendation 4). In 2021, HLTH and the PHO began an assessment of the effectiveness of drinking water protection plans (Recommendation 5). This work will be continued by WLRS. Prior to the reorganization in 2022, no action was taken by ENV (now the responsibility of WLRS), HLTH, or FOR to address regulatory conflicts between the *Drinking Water Protection Act* and *Water Sustainability Act* to prevent the creation of small water systems (Recommendation 6). Similarly, MUNI has not undertaken a review of the waiver of public assent for borrowing processes related to the installation of treatment infrastructure for local government drinking water systems under the Municipal Liabilities Regulation in the *Community Charter* (Recommendation 7).

A discussion of the actions taken by lead agencies to address these recommendations follows.

Recommendation 4: Legislative Framework Review

Evaluate the available legislative tools to protect sources of drinking water under the *Drinking Water Protection Act* and other Acts to identify any gaps, areas of overlap or conflict, and triggers for enforcement action. Establish improved processes for coordinating actions taken to compel compliance to protect drinking water. The evaluation should include a review of the tools available under the *Drinking Water Protection Act, Public Health Act, Water Sustainability Act, Environmental Management Act,* and *Forest and Range Practices Act*.

Leads: *Ministry of Health, Ministry of Environment and Climate Change Strategy, Ministry of Forests, Lands, Natural Resource Operations and Rural Development (now the Ministry of Forests)*[b]

[b] On October 19, 2023, after completion of this report, responsibility for the administration of water, land, fish, and wildlife was transferred from the Ministry of Forests (FOR) to the Ministry of Water, Land and Resource Stewardship. This transfer included the Water Management Branch and the Comptroller of Water Rights, which are referred to as being part of FOR throughout this report.

Progress and Next Steps

This recommendation is **complete.**

In 2022, the leads for this recommendation changed due to the creation of WLRS. The following describes actions taken by the initial leads during the reporting period prior to the government reorganization in 2022.

Since 2019, HLTH has concluded a review of legislation and legislative tools for source water protection and has created a technical working group to review source water risk assessment tools. ENV undertook policy research on the *Water Sustainability Act* objectives (section 43) and drinking water protection plans under the *Drinking Water Protection Act*.

The following provides additional information on legislative reviews undertaken by HLTH, ENV, FOR, and other ministries which may impact the protection of source water during the reporting period.

Source Water Protection Legislative Review

In 2021, HLTH retained Econics to undertake a comprehensive legislative review of all statutes and regulations that impact source water protection.[5] Econics reviewed 27 provincial Acts, regulations, and codes of practice, including (but not limited to) the *Drinking Water Protection Act*, the *Public Health Act*, the *Water Sustainability Act*, the *Emergency Management Act*, and the *Forest and Range Practices Act*, and concluded that:

- Most regulations are designed to regulate land-based activities that have or can have environmental impacts;
- Acts, regulations, and codes that have not been updated recently do not consider groundwater;
- Of the regulations reviewed, only the Contaminated Sites Regulation contained explicit provisions for future water sources;
- Most existing regulatory tools are reactive rather than proactive, which makes them ill-suited for source water protection and non-point pollution; and
- Most regulations do not afford higher levels of protection to water sources used for domestic or drinking water purposes, and so do not make those who are responsible for administration adopt a human health lens.[6]

Econics pointed out that the proactive tools in the existing regulatory framework, such as water sustainability plans, area-based management plans, and environmental management plans, have been used infrequently or not at all (e.g., drinking water protection plans provided for in the *Drinking Water Protection Act*). Additionally, many of these tools have not been tested to determine if they provide regulators with options for addressing risks to drinking water. As a result, Econics recommended that government pilot the use of existing regulatory planning tools and conduct a coordinated evaluation of their effectiveness.[6]

Review of Source Water Risk Assessment Tools

In 2021, HLTH created a technical working group to review source water risk assessment tools.[5] It included representation from the natural resource sector ministries.[5] In collaboration with partners, HLTH proposed a method for assessing risks to drinking water sources:[5] it is a modified version of the Cumulative Effects Framework – Aquatic Ecosystems Protocol.[5] Coordination of actions to assess risks will be evaluated with WLRS and other ministries.[5]

Review of Water Sustainability Act Objectives and Drinking Water Protection Plans

In 2021, ENV undertook a policy review of the *Water Sustainability Act* objectives (section 43) and drinking water protection plans under the *Drinking Water Protection Act* to identify areas of overlap and opportunities for regulatory tools to complement one another.[13] The findings have yet to be finalized but could inform a future review of drinking water protection plans and other source water protection tools.[13]

Forest and Range Practices Act

In October 2018, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (now FOR) initiated a multi-year legislative process to explore changes to the *Forest and Range Practices Act*.[14] The Act governs forest and range activities on public lands during forest planning, road building, timber harvesting, reforestation, and livestock grazing.[15]

In May 2019, FOR released a public Discussion Paper[16] on the *Forest and Range Practices Act* Improvement Initiative and solicited feedback from interested parties and the public. The *What We Heard, Forest and Range Practices Act*

Improvement Initiative: Renewal and Resilience report provides an overview of feedback received and identifies six themes for key changes to the Act.[17] While not explicitly stating it, two of these themes appear to include considerations for water:

1. Addressing climate change by embracing ecosystem-based management, managing the land base to maintain resilient ecosystems, and managing forests to promote forest health and reduce the risk of wildfires.
2. Implementing landscape-level planning to mitigate cumulative effects, adapt to climate change, integrate consideration of multiple resource values, and manage road access in collaboration with Indigenous Nations, communities, industries, and other affected resource users.[17]

FOR also published the *What We Heard from Indigenous Nations* report.[18] Indigenous Nations called upon the Province to adopt a more balanced approach to the management of timber and non-timber resource values, and stated that "all land and water should be managed and protected as part of an ecosystem-level approach to forest management".[18]

In 2019, FOR introduced a first round of amendments to *Forest and Range Practices Act* into legislation through the *Forest and Range Practices Amendment Act*, 2019 (Bill 21–2019).[19] A second round of amendments was introduced in 2021 through *Bill 23 – Forest Statutes Amendment Act* and included improvements to forest and range management that prioritize forest health and commitments to reconciliation.[15]

During summer 2021, FOR released an intentions paper, *Modernizing Forest Policy in British Columbia: Setting the Intention and Leading the Forest Sector Transition*.[20] At the time of writing this report, no further updates on the *Forest and Range Practices Act* Improvement Initiative were available.

Proposed Livestock Watering Regulations

Livestock that graze on rangeland drink water directly from streams and other water bodies, as well as from off-stream watering systems such as a water trough. Managing livestock watering by limiting access to riparian areas and keeping livestock out of streams helps protect water quality.

In 2018, ENV released the *Towards Livestock Watering Regulations under British Columbia's Water Sustainability Act* intentions paper.[21] It proposed new regulations that would improve livestock watering practices on Crown land or private rangelands where low-density livestock grazing occurs. The proposed regulations would allow the diversion of water from a stream or aquifer for livestock watering, and the construction of livestock watering works, subject to requirements that would minimize adverse effects on aquatic ecosystems.[21] In 2019, BC released the *What We Heard on Livestock Watering* document, which summarized the feedback received on the intentions paper.[22]

In 2020, ENV released an *Update on Proposed Livestock Watering Policy under the Water Sustainability Act*.[23] In the update, ENV proposed amending the *Water Sustainability Act* and Water Sustainability Regulation to provide a three-tiered approach to responding to changes in water supply and demand across the province, which would be tailored to different sizes of livestock operations. In some circumstances, livestock producers would be required to build off-stream watering structures or restrict which water sources their livestock could access. These changes would help protect water quality and maintain water supply.[23]

At the time of writing this report, no further updates on the status of the Livestock Watering Regulation were available.

Organic Matter Recycling Regulation

The Organic Matter Recycling Regulation regulates the production and land application of compost and biosolids.[24] It was enacted in 2002 under the joint authorities of the *Environmental Management Act* and the *Public Health Act*. ENV is revising the regulation to improve the protection of human health and the environment.[25]

In September 2018, ENV released the *Organic Matter Recycling Regulation Policy Intentions Paper*.[25] It proposed updates to the regulation to address:

- Opportunities for increased public transparency and information sharing;
- Additional requirements for improved notification for land application of biosolids;
- Requirements for engagement with First Nations; and
- Requirements for authorization.[25]

In June 2022, ENV released the *Organic Matter Recycling Regulation Project Update*.[26] While the Ministry's overall policy direction remained unchanged from the 2018 intentions paper, refinements to policy and technical standards were made.[26] With respect to drinking water, the following updates are of note:

- The Ministry will update the Organic Matter Recycling Regulation requirements for biosolids that relate to metals and will adopt the National Standard of Canada, which is generally more protective than the current Organic Matter Recycling Regulation standards.[26]
- The Ministry intends to amend the Organic Matter Recycling Regulation to add authority for a director to require assessment of biosolids for contaminants of emerging concern.[26,c]

Code of Practice for Agricultural Environmental Management

In February 2019, the *Code of Practice for Agricultural Environmental Management*[27] replaced the Agricultural Waste Control Regulation. The *Code of Practice for Agricultural Environmental Management* is a regulation under the *Environmental Management Act* that regulates the storage and use of manure, other agricultural by-products, and materials on agricultural operations.[28] It includes general rules for applying nutrients to the land, and outlines soil sampling and analysis requirements. Farmers must keep records of the type and amount of nutrients they apply to their fields, including when and where they were applied. Additional measures are required for operations in high-risk areas (e.g., areas with high rainfall or that are located over vulnerable aquifers) and those operating during high-risk conditions (e.g., high rainfall months of October through March on the South Coast).[28] Some operators in high-risk areas may need to prepare a nutrient management plan if their operations meet certain conditions. These plans guide the application of nutrients to the land to prevent source water contamination.[29] It is not yet clear what effect the new code has had on drinking water; this will need to be monitored over time.[30]

Expiry of Contaminated Soil Landfill Deferral Order

The Contaminated Soil Landfill Deferral Order expired in January 2021. At that time, ENV put in place an interim operational policy to guide ministry staff during the review of authorizations for the disposal of contaminated soil. To help landfill owners, operators, and qualified professionals understand the considerations that statutory decision makers identify when assessing applications for landfills to accept or increase quantities of contaminated soils, ENV released the Interim Considerations for Landfills Accepting Contaminated Soils Factsheet.[31] It provides recommendations to help protect drinking water sources, such as (but not limited to) the following:

- Landfills should not be sited within a designated community watershed.
- Increases to the minimum setback from the landfill footprint to a water supply well, intake, or future drinking water source should be considered when there is high hydraulic conductivity and/or a high hydraulic gradient.
- Landfills should not be sited over an aquifer if the presence of the landfill creates a high-risk aquifer classification.[31]

The interim considerations are additional to those in existing guidance materials, including the *Landfill Criteria for Municipal Solid Waste*[32] and the *Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*.[33] Landfills continue to require site-specific authorizations (permits, operational certificates, or approvals) under the Waste Discharge Regulation.[31]

There have been no new approved authorizations for the disposal of contaminated soil since the Order expired because more soil is being cleaned with soil cleaning technology and remediated instead of being landfilled.[34] Also, the interim considerations and guidance materials are intended to help ensure that toxic material, such as contaminated soil, does not end up in the landfill, over aquifers, or near water supply well intakes. In addition, guidance is provided on landfill design and operation, monitoring, and closure requirements that are intended to help protect drinking water.

[c] Contaminants of emerging concern are chemical substances, including endocrine-disrupting compounds, that may be present in biosolids due to the use of pharmaceuticals, personal care products, fire retardants, and other products.

Scientific Review of Hydraulic Fracturing in BC

In February 2019, an independent scientific panel produced a report for the Ministry of Energy, Mines and Low Carbon Innovation on the practice of hydraulic fracturing and BC's associated regulatory regime: *Scientific Review of Hydraulic Fracturing in British Columbia*.[35] The panel concluded that the regulatory regime appears robust, but it identified improvements that could be made, including conducting research to address targeted knowledge gaps.[36]

The Ministry of Energy, Mines and Low Carbon Innovation and the BC Energy Regulator assessed the recommendations made in the report. In response, they developed an action plan to improve regulatory and policy tools and processes, increase scientific research and baseline monitoring, and improve relations with the public and Indigenous Peoples. Examples of work done to address water quality and water quantity concerns, induced seismicity, fugitive emissions, and other risks, such as orphan wells; cumulative effects; and Indigenous engagement, include:

- The Pilot Collaborative Water Monitoring Program in northeast BC that brings together First Nations, the Province, industry, and Geoscience BC;
- The University of BC's Energy and Environmental Research Initiative on the potential transmission of fugitive emissions in groundwater;
- Collaboration with First Nations on sampling water quantity and quality, groundwater, and benthic invertebrates; and
- Government-to-government cumulative effects assessments of water quality and quantity disturbance associated with resource development activity.[36]

These initiatives aim to improve scientific knowledge about water baseline conditions in northeast BC. This growing body of knowledge may be useful for subject matter experts to inform location-specific water baseline conditions.

Recommendation 5:
Drinking Water Protection Plans

Review the objectives and effectiveness of drinking water protection plans under the *Drinking Water Protection Act* as a source protection tool to determine if changes to the Act could enable more collaborative and proactive source protection that would be legally binding.

Leads: *Ministry of Health, Office of the Provincial Health Officer*

Progress and Next Steps

This recommendation is **in progress.**

In 2022, the leads for this recommendation changed due to the creation of WLRS. The following describes actions taken by the initial leads during the reporting period prior to the government reorganization in 2022.

In 2019, the OAG echoed this PHO recommendation in its report, *The Protection of Drinking Water*. The OAG recommended that "the Provincial Health Officer, in collaboration with HLTH, review the legislative provisions regarding drinking water protection plans and report to the Minister of Health on impediments to the protection plans' implementation."[4]

In response, the PHO and HLTH launched a preliminary review of drinking water protection plans in 2021. It considered impediments to recommending, developing, and implementing these plans, and included a jurisdictional scan of source protection tools and a review of planning tools under the *Water Sustainability Act*, the *Environmental Management Act*, and other community-based planning measures. Key interested parties and ministries that have a role in source water protection were interviewed, including HLTH, the PHO, and regional health authorities. The following needs related to drinking water protection plans were identified:

- A minimum requirement for source and system assessments under the *Drinking Water Protection Act* should be considered;
- Policy and guidance related to drinking water protection plans is needed; and
- The thresholds for initiating and approving a drinking water protection plan under Part 5 of the *Drinking Water Protection Act* need to be reconsidered because the current test for initiating a plan is ambiguous and difficult to prove.

General recommendations stemming from the review also included the need for a clearly designated lead agency for source water protection and planning, a provincial source water protection strategy, and watershed-level avenues for relationship building and decision-making. Further work on Recommendation 5 was delayed due to the reorganization of the natural resource ministries and transition of leadership for source water protection to the new Ministry of Water, Land and Resource Stewardship.

Due to the establishment of this new ministry and its mandate to lead and coordinate both the Source-to-Tap Strategy for drinking water and the Watershed Security Strategy, the general recommendations from this review have largely been completed or are in progress. Given this change in the governance of drinking water protection, the preliminary findings from the review of drinking water protection plans have been shared with WLRS. WLRS and the PHO, in collaboration with HLTH, will relaunch this work on drinking water protection plans as part of a review of source water protection tools to support the development of a new provincial Source-to-Tap Strategy.

Recommendation 6: Regulatory Conflict with the *Water Sustainability Act*

Collaborate on policy options to address regulatory conflicts between the *Drinking Water Protection Act* and the *Water Sustainability Act* regarding protecting sensitive aquatic environments under the *Water Sustainability Act* through the construction of joint intake waterworks and preventing the creation of new small water systems under the *Drinking Water Protection Act*.

Leads: *Ministry of Environment and Climate Change Strategy, Ministry of Health*

Progress and Next Steps

No action has been taken on this recommendation.

In 2022, the leads for this recommendation changed due to the creation of WLRS. The following describes actions taken by the initial leads during the reporting period prior to the government reorganization in 2022.

While HLTH confirmed that FOR supports collaborating to address this recommendation, and both ENV (now the responsibility of WLRS) and HLTH have worked on a response to the 2019 OAG report and have participated on the Executive Directors Steering Committee on Drinking Water, these actions do not directly address the conflict in legislative mandates related to the creation of joint water works (see Section 2.2.6 [Chapter 2]). Work on this recommendation was also delayed due to the reorganization of the natural resource ministries and the transition of governance to the new ministry.

The difference in mandates and interpretation of joint works, along with differences in what constitutes a water supplier and a water supply system under the *Drinking Water Protection Act* compared to the *Water Sustainability Act* and *Water Users' Community Act* continues to create challenges by:

- Authorizing the construction of joint works for domestic use without reference to the *Drinking Water Protection Act*;
- Contributing to the proliferation of unsustainable small water systems (which are often plagued with poor water quality, inadequate treatment, long-term boil water notices, and limited operational and management capabilities) under the *Drinking Water Protection Act*; and
- Creating compliance challenges, which places a significant strain on limited health authority resources.

The work needed to address this recommendation should include identifying a common understanding of a water supply system and water supplier as it relates to domestic water use and joint works, and exploring whether changes to the definition of a water supply system under the *Drinking Water Protection Act* are necessary to reduce conflicts and allow for more flexibility for joint works. All parties and WLRS, FOR, and HLTH will need to work together to ensure any changes do not negatively impact the protection of public health or the scope and mandate of the *Water Sustainability Act*.

Furthermore, according to Recommendation 12 of the 2019 PHO drinking water report, HLTH and FOR should commit to developing policies and procedures to ensure collaboration on the approval and oversight of water users' communities to improve their capacity, accountability, and sustainability as a water supplier.[2] This work overlaps with

Recommendation 6 and will be carried forward as one recommendation. Addressing these concerns will not only reduce compliance issues and conflicts in mandates but will also support Recommendation 9 of the 2019 PHO drinking water report regarding the development of a small water system strategy for BC.

Recommendation 7:
Public Assent Processes and the *Community Charter*

Review the waiver of public assent for borrowing processes related to the installation of treatment works for local government drinking water systems under the Municipal Liabilities Regulation in the *Community Charter*. Identify an alternate strategy to remove barriers to borrowing for necessary infrastructure improvements while also providing a streamlined opportunity for public assent. As part of this review, consider the liquid/solid waste management plans under the *Environmental Management Act* as a model.

Leads: *Ministry of Municipal Affairs, Ministry of Health*

Progress and Next Steps

No action has been taken on this recommendation.

As a result of the COVID-19 pandemic and the need to redirect MUNI's resources, the preliminary review of alternative models for public assent was put on hold.[37]

11.3.3 Information Management and Information Technology

To improve the oversight, evaluation, and reporting of the drinking water program in BC, it is necessary to have data that are useful, consistent, and readily available. However, information on drinking water and source supplies in BC remains decentralized, inconsistent, and difficult to access. To begin to address this gap, the PHO, in consultation with the regional health authorities and HLTH, developed new indicators to inform reporting. The indicators were introduced in the 2019 PHO report. These changes to data collection and reporting will lead to improved understanding and evaluation of provincial drinking water protection programs and will enable a better understanding of the risks to drinking water systems. For this new reporting structure to succeed, Recommendation 8 called for a) further work and resources to implement data system changes, and b) a provincial strategy to ensure data collected are relevant, reliable, consistent, and accessible.

The regional health authorities and HLTH have made progress in addressing both parts of this recommendation.

Recommendation 8a:
Requirements for Reporting by the Office of the Provincial Health Officer

Continue to adapt health authority data systems to align with the new indicators, reporting data requirements, and water system categories developed collaboratively by the Office of the Provincial Health Officer, the regional health authorities, and the Ministry of Health, and be able to report out on such data within five years of the publication of this report.

Leads: *Regional health authorities in consultation with the Office of the Provincial Health Officer*

Progress and Next Steps

This recommendation is **in progress.**

The regional health authorities support the PHO in reporting on drinking water systems through data collection and modifications to their databases. However, they continue to express concerns about the limitations of their data systems to collect, store, and retrieve drinking water system information. The COVID-19 pandemic also impacted the regional health authorities' data collection and reporting efforts. For example, in 2020/21, Vancouver Coastal Health reported that its information technology staff were redirected to case management and contact tracing,[38] and Interior Health indicated that its responses to the pandemic created staff shortages, which resulted in gaps in reporting on small water systems.[39]

The following provides additional information on activities undertaken by the regional health authorities in response to this recommendation.

Modifications of Health Authority Databases to Collect Data on PHO Drinking Water Indicators

Before the pandemic, the regional health authorities began modifying their databases to improve data collection and reporting on the PHO drinking water indicators. In 2016, Interior Health partnered with the PHO on a pilot project to configure the health authority's information system to capture and report on the new indicators.[39] Fraser Health mapped data fields for capturing the new indicators and asked its database vendor to modify its system.[40] Vancouver Coastal Health collaborated with Fraser Health to modify HealthSpace, and it plans to share new indicator fields created in the HealthSpace platform with other regional health authorities.[38] Island Health transitioned to a new database, and staff are working to update it to include the new indicators.[41] Northern Health also made improvements to its database by creating reporting views to help with data requests.[42]

The regional health authorities anticipated that updates made to their information systems to capture the indicators would be completed by 2024. However, due to the COVID-19 pandemic and resulting backlog in work, they may find it difficult to meet this deadline. The regional health authorities are also participating in the HLTH-led Environmental Health Information System project, which includes the Drinking Water Information System described in Recommendation 8b. A provincial data system for drinking water will enable the regional health authorities to report to the PHO in a timely manner.

Data Collection

In addition to modifying their databases, some regional health authorities have taken further steps to collect drinking water system data, including reviewing information system needs to identify solutions[39] and improve data collection and reporting,[39,41] and focusing on collecting key facility information for the PHO drinking water indicators.[39,42]

Despite these efforts, the regional health authorities are challenged with reporting due to the limitations of their information systems, the backlog of work resulting from the COVID-19 pandemic, and the lack of available resources for collecting data and reporting on drinking water and drinking water systems.

Recommendation 8b:
Provincial Information Management and Information Technology Strategy

Develop a provincial strategy to ensure data collected are relevant, reliable, consistent, and accessible, and which builds on the indicators and water system categories developed collaboratively by the Office of the Provincial Health Officer, the regional health authorities, and the Ministry of Health.

Leads: *8b Ministry of Health, regional health authorities in consultation with the Office of the Provincial Health Officer*

Progress and Next Steps

This recommendation is **in progress.**

HLTH is leading the development of a provincial Drinking Water Information System (as part of the larger provincial Environmental Health Information System). In February 2021, the Office of the Chief Information Officer approved the Drinking Water Information System as a priority project for HLTH. In 2022, CGI, on behalf of HLTH, engaged with partners, including the PHO and the regional health authorities, to gather information on data requirements, the current state of data systems, and the needs and constraints of all partners and interested parties related to drinking water and the Drinking Water Information System.[43]

In December 2022, outside of the reporting period but during the development of this report, the Population and Public Health assistant deputy minister, the Health Sector Information Management/Information Technology assistant deputy minister, WLRS, and PHO approved a Health Sector Information Management/Information Technology Division-led discovery phase for a solution for the Drinking Water Information System. Further, they expanded the project's scope to a broader Environmental Health information System that includes modules for other public health programs such as Food Safety, and Tobacco and Vapour Products. The discovery phase project started in January 2023, and a business case was developed. Funding options were explored during summer 2023 and development of the system commenced later that fall.[43]

HLTH is also working with key partners, including the PHO and regional health authorities, to standardize key data elements for drinking water systems in order to implement the Drinking Water Information System module. The PHO indicators are included as data elements for this project.[43]

11.3.4 Small Water System Governance and Sustainability

The 2019 PHO drinking water report outlined the financial and management capacity issues that small water systems face, and the progress BC has made to address those challenges. In addition, the report highlighted the unique governance challenges faced by specific types of water systems, such as improvement districts, private water utilities, water users' communities, and "good neighbour systems". Recommendations 9–12 were aimed at improving small water system governance and sustainability.

Progress on small water systems governance and sustainability has been slow. HLTH has not established an oversight body to develop a small water system strategy (Recommendation 9) but has begun to coordinate with WLRS to develop a provincial Source-to-Tap Strategy that will include a small water system strategy. No action as been taken by MUNI on the amalgamation, acquisition, and conversion of small water systems (Recommendation 10). Similarly, government (FOR, MUNI, and HLTH) has yet to identify a strategy to ensure that customers of private water utilities that have fallen into escheat are provided with well-managed, safe, and reliable drinking water (Recommendation 11). The FOR Comptroller of Water Rights office continues to encourage water users' communities to operate in compliance with the *Water Users' Community Act*, *Water Sustainability Act*, and any other legislation that may apply to them. However, a difference in mandates, definition of a water supplier, and authorization of joint works for the purposes of diverting water for domestic use still exists under multiple statutes, which is creating unsustainable small water systems in BC (Recommendation 12).

A summary of the actions taken by lead agencies to address these recommendations follows.

Recommendation 9: Small Water System Strategy

Recommit to an oversight body to develop a small water system strategy to (1) prevent the development of new unsustainable small water systems during subdivision development, (2) promote amalgamation and acquisition of small water systems, and (3) build capacity and sustainability of existing small water systems.

Lead: *Ministry of Health*

Progress and Next Steps

This recommendation is **in progress.**

HLTH has not established an interagency oversight body to develop a small water system strategy. However, in 2021, HLTH organized the interagency Executive Directors Steering Committee on Drinking Water to address issues of drinking water governance. HLTH also began coordinating with WLRS to develop a provincial Source-to-Tap Strategy, which will encompass the development of a small water system strategy led by HLTH and WLRS.

The following outlines information on activities HLTH and partner ministries (including FOR, MUNI, and the Ministry of Transportation and Infrastructure) have undertaken to (1) prevent the development of new unsustainable small water systems during subdivision development, (2) promote amalgamation and acquisition of small water systems, and (3) build capacity and sustainability of existing small water systems.

Preventing the Development of New Unsustainable Small Water Systems

During this reporting period, no new initiatives or strategies were developed to prevent the development of new unsustainable small water systems. Instead, FOR, MUNI, and the Ministry of Transportation and Infrastructure continued to rely on existing tools to prevent small water systems from being created during subdivision development. These include subdivision approval protocols specified by the Ministry of Transportation and Infrastructure that require a Certificate of Public Convenience and Necessity issued by the Comptroller of Water Rights under the *Water Utility Act*.[44] Developers are required to meet administrative, technical, and financial requirements for a Certificate of Public Convenience and Necessity approval, as outlined in FOR's *Guide to Applying for a Certificate of Public Convenience and Necessity (CPCN)*[45] and the Ministry's *Design Guidelines for Rural Residential Community Water Systems*.[44,46] Additional requirements for maintaining financial viability of a private water utility include compliance with various financial conditions and requirements during the development stage (i.e., utility's water tariff to ensure fair and reasonable customer rates and requirements for developers' contributions to various trust funds [i.e., Revenue Deficit Reserve Fund, Replacement Reserve Fund,

and the Deferred Capacity Reserve Fund]).[44] These tools help create incentives for new developments to use existing water systems rather than causing a proliferation of small water systems.

MUNI also continues to promote and encourage development densification and to leverage existing infrastructure and service delivery over the creation of new water systems.[47]

From 2017/18 to 2021/22, the Ministry of Transportation and Infrastructure did not take specific policy or legislative action to prevent the development of new unsustainable small water systems. However, it indicated that it is willing to work with other co-leads (HLTH, MUNI, and FOR) to develop a small water system strategy.[48]

While all ministries continue to encourage sustainable water system development, a provincial strategy and legislative backstop is still needed to prevent the creation of additional small water systems.

Promoting Amalgamation and Acquisition of Small Water Systems

During this reporting period, no new initiatives or strategies were developed to promote the amalgamation and/or acquisition of small water systems. FOR, MUNI, and the regional health authorities encourage and support small water systems to seek a connection or transfer of ownership to local government systems; however, the number of amalgamations or acquisitions each year remains low. Some regional districts have moratoriums on the number of small water systems they are willing to acquire, which limits transfer of ownership options for small water systems in those regions.

Building Capacity and Sustainability of Existing Small Water Systems

During this reporting period, FOR updated the *Guide to Applying for a Certificate of Public Convenience and Necessity* to reflect current technical standards, while implementing more stringent financial requirements for Certificate of Public Convenience and Necessity approvals.[44] FOR also encourages private regulated water utilities to make applications for rate increases to ensure their rates meet the utility's ongoing operational and maintenance requirements, and to make adequate contributions to the utility's Replacement Reserve Fund to ensure funds are available for future water system replacement. Developer contributions made as an aid in future construction through contributions to the Deferred Capacity Reserve Fund also contribute to the financial resources available for future system capacity increases.[44] While the utilities are encouraged to provide financial plans and applications for rate increases, enforcement of those requirements is challenged.

Since 2019, HLTH has been working with the BC Water and Waste Association to expand the project "Building Sustainable Small Water Systems in BC" to develop capacity, a knowledge base, and tools to support small water systems.[5] MUNI staff also participated as an interested party in the project.[47] The outcomes of this work will help inform the development of a future small water system strategy.[5]

In September 2020, the BC Water and Waste Association established an advisory committee to oversee this project.[5] The committee included representation from the health authorities, Indigenous Service Canada, PHO, and HLTH.[5] During fall 2020, the Association conducted surveys and workshops with small water system owners, operators, and supporters to determine what training materials and delivery approaches they required.[5]

In December 2020, the BC Water and Waste Association provided HLTH with two reports: one summarized the outcomes of the survey and workshops; the other outlined the design criteria for the network infrastructure.[5] The COVID-19 pandemic delayed components of this work because the engagement plan was originally designed for in-person sessions and needed to be redesigned for the virtual environment.[5]

The Association launched the network infrastructure in June 2021 and began offering virtual courses.[5]

Recommendation 10:
Amalgamation, Acquisition, and Conversion

10a. Develop and resource a strategic approach to encourage and facilitate the conversion of improvement districts, using established best practices.

10b. Develop best practices and guidance for local government for the development and implementation of an acquisition and amalgamation plan for small water systems.

10c. Identify resources required to develop dedicated funding to a) assist and provide incentive to local governments in the amalgamation or acquisition of small water systems, and b) support the conversion of improvement districts.

Lead: *Ministry of Municipal Affairs*

Progress and Next Steps

No action has been taken on this recommendation.

MUNI has not developed or resourced a strategic approach to facilitate conversion of improvement districts, nor has it developed best practices and guidance for local government on developing and implementing an acquisition and amalgamation plan for small water systems. The existing infrastructure funding programs (e.g., Investing in Canada Infrastructure Program – British Columbia - Green Infrastructure - Environmental Quality Program)[49] can support the conversion of improvement districts or acquisition of small water systems by local governments. The Ministry provides restructuring advice and support when this is requested.[47]

Although MUNI continues to support improvement district conversion through existing policies and frameworks, a proactive approach as part of a broader provincial small water system strategy is still missing. As stated in Section 2.2.4 (Chapter 2), 16 improvement district conversions occurred between the reporting period of 2017–2022; however, 153 improvement districts that are authorized to provide water remain. There are examples of improvement districts that are well managed, but smaller improvement districts may struggle to provide potable water to their users. Given the ongoing challenges with improvement districts, it is imperative that a strategy to support their conversion is incorporated into the Province's small water system strategy, which is part of the Province's commitment to developing a Source-to-Tap Strategy for drinking water.

Recommendation 11:
Utilities and the *Escheat Act*

Identify a strategy to ensure that customers of private water utilities that have fallen into escheat are provided with well-managed, safe, and reliable drinking water as quickly as possible.

Lead: *Ministry of Forests, Lands, Natural Resource Operations and Rural Development (now the Ministry of Forests)*[d]

Progress and Next Steps

No action has been taken on this recommendation.

Currently, when the governing body of a water system dissolves, the company or society that owned and operated the system no longer exists.[44] In these cases, the Attorney General takes ownership of the escheated system and its assets, and assumes full responsibility for its management and operation.[44] The Comptroller of Water Rights staff provide the Attorney General's office with records that are pertinent to utility assets (e.g., as-built drawings, financial reports and statements, customer rates, and current water tariff documents) and identifies system deficiencies.[44] On an as-needed basis, the Comptroller's staff provide support services to the Attorney General's office on various aspects of utility operations.[44] This may include making recommendations for hiring qualified operators, establishing fair and reasonable customer rates, and liaising with other parties that have the potential for future ownership of utility assets (i.e., transfer to a local government).[44]

In accordance with the *Drinking Water Protect Act*, the regional health authority forwards to the Attorney General's office any public health and safety concerns and requirements necessary for the Attorney General to rectify non-compliance issues.[44]

[d] On October 19, 2023, after completion of this report, responsibility for the administration of water, land, fish, and wildlife was transferred from the Ministry of Forests (FOR) to the Ministry of Water, Land and Resource Stewardship. This transfer included the Water Management Branch and the Comptroller of Water Rights, which are referred to as being part of FOR throughout this report.

While FOR has an existing process for managing private water utilities that have fallen into escheat, the process is cumbersome and poses challenges in terms of increased costs and liability for local and provincial governments. A strategy to ensure that customers of private water utilities that have fallen into escheat are provided with well-managed, safe, and reliable drinking water as quickly as possible still needs to be developed as part of the small water system strategy.

Recommendation 12: Water Users' Communities

Identify opportunities for greater collaboration on the approval and oversight of water users' communities in order to improve capacity, accountability, and sustainability.

Lead: *Ministry of Forests, Lands, Natural Resource Operations and Rural Development (now the Ministry of Forests)*[e]

Progress and Next Steps

No action has been taken on this recommendation.

Through information provided on its website, FOR's Comptroller of Water Rights office encourages water users' communities to operate in compliance with the *Water Users' Community Act* and the *Water Sustainability Act* and any other legislation that may apply to them.[50] The office provides support to water users' communities regarding the *Water Users' Community Act* and the *Water Sustainability Act*;[50] however, the level of oversight is minimal compared to what is provided to water utilities. During spring 2022, the Comptroller of Water Rights office contacted those water users' communities for which there had been no correspondence for a few years to ask if they were still operational.[50] In the future, the office will review the state of some water users' communities to determine if they need to be dissolved according to the *Water Users' Community Act*.[50]

Despite these activities, no concrete actions have been taken to identify opportunities for collaboration between FOR, HLTH, and drinking water officials on the approval and oversight of water users' communities.

As mentioned in Recommendation 6, which relates to this recommendation, work on addressing issues regarding water users' communities and other types of small water systems was delayed due to the reorganization of the natural resource ministries and the transition of governance to WLRS. Given the overlap of these recommendations, they will be carried forward as one recommendation for WLRS to lead in collaboration with FOR and HLTH.

11.3.5 Elements of the Multi-barrier Approach – Specific Recommendations

The 2019 PHO drinking water report outlined the system of procedures, processes, and tools that form the multi-barrier approach to ensuring the availability of clean, safe, and reliable drinking water. The three core elements of the approach are source protection, treatment, and distribution system integrity. These elements are supported by an integrated system of total quality management, which includes good operations and management, monitoring and reporting, and abatement and enforcement programs. Recommendations 13–32 relate to specific areas of concern regarding each element of the multi-barrier approach and identify areas where improvements are needed.

Since the release of the 2019 PHO drinking water report, considerable work has been done to address Recommendations 13–32 despite the resourcing and logistical challenges posed by the COVID-19 pandemic and the major flooding that occurred across south-central and southern BC in 2021. While work on developing provincial guidelines for bulk water haulers (Recommendation 20) and developing minimum training standards for small water system operators (Recommendation 22) has not begun, 10 recommendations are in progress, five are ongoing, and four have been completed. Completed work includes the creation of design and performance standards for evaluating treatment process against treatment objectives, and the design of waterworks (Recommendation 15); development of sampling and reporting protocols for lead in school drinking water (Recommendation 19a); development of measures to reduce lead in the drinking water of child care facilities

[e] On October 19, 2023, after completion of this report, responsibility for the administration of water, land, fish, and wildlife was transferred from the Ministry of Forests (FOR) to the Ministry of Water, Land and Resource Stewardship. This transfer included the Water Management Branch and the Comptroller of Water Rights, which are referred to as being part of FOR throughout this report.

(Recommendation 19b); and establishment of a process to verify that drinking water system operators are certified (Recommendation 21).

A summary of the actions taken by lead agencies to address these recommendations follows.

Recommendation 13:
Source and System Assessment

Develop a work plan to ensure that all water suppliers have a source and system assessment on record that identifies potential risks and vulnerabilities; this assessment can then be used to develop a response plan for source and system protection.

Lead: *Regional health authorities*

Progress and Next Steps

This recommendation **is ongoing.**

The regional health authorities are at various stages of developing work plans to ensure drinking water suppliers have completed drinking water source and system assessments, and of collecting source and systems assessment data in their information systems. In addition, some regional health authorities have developed guidance to help environmental health officers conduct source and system assessments. However, the COVID-19 pandemic affected the regional health authorities' ability to fulfill this recommendation.

The following provides additional information on activities undertaken by the health authorities in response to this recommendation.

Drinking Water Source and System Assessments

In some regional health authorities, large community water systems have completed comprehensive assessments;[39] in others, all small water systems have completed simplified assessment tools.[40] Some health authorities outline drinking water system risks and vulnerabilities in each facility's inspection or assessment report,[38] and some assessments are conducted as part of the construction permitting process.[42] Given the variety of approaches taken by the regional health authorities in ensuring drinking water systems complete source assessments, it is clear that they need guidance on what type of assessment is required for different types and sizes of drinking water system.

Database Enhancements

The new indicator project led by the PHO has identified the completion of source water assessments and development and implementation of source protection plans as source protection indicators for future reporting. The regional health authorities are at various stages of collecting these data in their information systems.

For more information on source assessments, see Chapter 3 of this report.

Recommendation 14:
Treatment Objectives

Develop a process to uniformly review water systems to identify which systems do not meet the BC surface or groundwater treatment objectives. This review will inform the development of financial plans and compliance processes to meet the treatment objectives and will help identify where resources are best directed to achieve identified target dates for improvements.

Leads: *Ministry of Health, Ministry of Municipal Affairs, regional health authorities*

Progress and Next Steps

This recommendation is **in progress.**

HLTH, MUNI, and the regional health authorities started to develop processes for reviewing water systems to identify those that do not meet the BC surface water or groundwater treatment objectives, but this work was delayed by the COVID-19 pandemic response. The information from this review would inform the development of financial plans and compliance processes to help water systems meet the treatment objectives. While the provincial process for reviewing and identifying systems that do not meet the BC surface water or groundwater treatment objectives has been delayed, the federal *Investing in Canada Infrastructure Program*[51] prioritizes funding for drinking water projects that meet or exceed provincial standards. The federal program also includes a target for the reduction of long-term drinking water advisories.

The following provides additional information on activities undertaken by HLTH, MUNI, and the regional health authorities in response to this recommendation.

Guidelines for Pathogen Log Reduction Credit Assignment

In January 2022, as a first step in developing a process to identify drinking water systems that do not meet provincial drinking water treatment objectives, HLTH developed *Guidelines for Pathogen Log Reduction Credit Assignment*.[5,52] The guidelines provide direction on pathogen log-reduction requirements and credit assignment to produce microbiologically safe drinking water based on source water type and water treatment process(es).[5]

By incorporating pathogen log-reduction information into drinking water information systems, health officials will be able to inventory permitted drinking water systems and identify those that do not meet the provincial drinking water treatment objectives.[5]

Identifying Water Systems that Do Not Meet the BC Surface Water or Groundwater Treatment Objectives

The regional health authorities have taken steps to review water systems and identify those that do not meet BC surface water or groundwater treatment objectives. Some have modified their databases to capture treatment objective information;[39] others plan to update their systems soon. A few regional health authorities have developed guidelines to help environmental health officers determine when systems are not meeting treatment objectives; others have put processes in place to ensure systems come into compliance with the objectives.[38,40,42] However, efforts by the regional health authorities were interrupted by the COVID-19 pandemic response and staffing shortages. Regional health authorities pointed out that additional resources are required to perform this review because the data collection and data entry required for every water system is extensive.

Recommendation 15:
Design and Performance Standards

Develop provincial guidance for a) the assignment of log-reduction credits for the evaluation of treatment processes against treatment objectives, and b) the design of waterworks.

Lead: *Ministry of Health*

Progress and Next Steps

This recommendation is **complete.**

In January 2022, HLTH released the:

- *Guidelines for Pathogen Log Reduction Credit Assignment*;[52] and
- *Guidelines for Ultraviolet Disinfection of Drinking Water*.[53]

Both guidance documents were incorporated into Part B of the *Drinking Water Officers' Guide*[54] and were posted on the HLTH website "How Drinking Water is Protected in B.C."[5,f] Additionally, new *Design Guidelines for Drinking Water Systems in British Columbia*[55] were published by HLTH in March 2023.

Recommendation 16:
Distribution System Integrity and Maintenance

Develop provincial guidance for drinking water officers for the review and assessment of distribution integrity, management, and maintenance that considers the varying sizes, capacities, and complexities of water systems.

Lead: *Ministry of Health*

Progress and Next Steps

This recommendation is **in progress.**

Similar to treatment, maintaining distribution system integrity requires a multi-barrier approach.

Typical hazards associated with distribution systems include cross-connections and infiltration of contaminants from breaches in pipe integrity (e.g., leaks and main breaks), pathogen regrowth and formation of biofilms, and heavy metal contamination due to pipe corrosion or the accumulation of heavy metals (e.g., manganese) from source water in distribution piping. These risks can be managed through distribution system design and layout, and maintenance of system pressure; proper operations and maintenance (i.e., through the implementation of an operations and maintenance plan/ management plan); maintenance of disinfection residuals; cross-connection control programs; and corrosion control measures.

[f] *https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/drinking-water-quality/how-drinking-water-is-protected-in-bc*

To gauge the progress that water supply systems are making in protecting distribution systems, the PHO and regional health authorities identified a set of key indicators for future reporting. They were introduced in the 2019 PHO drinking water report and include:

- Having a cross-connection control program and/or backflow prevention devices in place.
- Monitoring and maintaining disinfection residuals within the distribution system.
- Following a leak and pressure detection plan or schedule that meets best practices or operating permit requirements.
- Following a maintenance plan and schedule that meets best practices or operating permit requirements.
- Having a corrosion control program or plan in place where required.

The size and complexity of these plans and programs will vary based on water quality and chemistry, as well as the size and complexity of the distribution system. For example, small water systems rely mainly on user education and standard operating procedures, whereas larger local government systems may have cross-connection control bylaws, dedicated staff, and programs for distribution system maintenance.

Currently, the *Drinking Water Officers' Guide*[54] includes limited guidance for drinking water officers on assessing distribution system integrity using these indicators. However, HLTH has developed some guidance for distribution system integrity and has updated the *Drinking Water Officers' Guide* to include the 2016 *British Columbia Guidelines (Microbiological) on Maintaining Water Quality in Distribution Systems*[56] and the 2019 *Interim Guidelines on Evaluating and Mitigating Lead in Drinking Water Supplies, Schools, Child Care Facilities and Other Buildings*.[5,57] Additional guidance is provided in the *Design Guidelines for Drinking Water Systems in British Columbia*,[55] which was released in March 2023. While these documents provide useful guidance on distribution system design requirements, secondary disinfection, and assessing the need for corrosion control by monitoring for lead, guidance on the assessment of cross-connection control and distribution system maintenance programs is still needed.

Recommendation 17:
Secondary Disinfection

Systematically review all water systems to identify which systems do not provide secondary disinfection, and of those, which will require secondary disinfection as per the *British Columbia Guidelines (Microbiological) on Maintaining Water Quality in Distribution Systems*. Continue to promote secondary disinfection for all drinking water systems as best practice.

Leads: *Regional health authorities*

Progress and Next Steps

This recommendation is **ongoing.**

The regional health authorities have taken steps to identify water systems that do not provide secondary disinfection as required in the *British Columbia Guidelines (Microbiological) on Maintaining Water Quality in Distribution Systems*.[56] Some regional health authorities have identified water systems in their jurisdiction that do not provide secondary disinfection;[38,40] others have yet to begin this work.[39,41,42] Although some regional health authorities are making progress in implementing this recommendation, their data systems are still not equipped to report on this indicator of distribution system integrity.

Recommendation 18:
Cross-connection Control

Ensure water supply systems have appropriate plans/procedures in place to proactively identify and address cross-connections. Encourage all local government water purveyors to have an enforceable cross-connection control program.

Leads: *Regional health authorities*

Progress and Next Steps

This recommendation is **ongoing.**

Regional health authorities are working toward ensuring drinking water supply systems have plans and procedures in place to identify and address cross-connections. Some regional health authorities use their database to track the status of cross-connection control programs.[38,39] Others have yet to begin a formal process of ensuring that systems have cross-connection control

programs in place.[41,42] Programs that are in place tend to be for large water systems.[38,39,42] Many small water systems have not yet instituted cross-connection control programs.[42]

Working with community water systems to ensure effective reporting of key cross-connection control program information demonstrates that communities are following safe practices, which is essential for maintaining the confidence of water system users and is a critical element of a multiple-barrier approach to achieving safe, clean, and sustainable drinking water.

Community Cross-connection Control Programs

In BC, the BC Water and Waste Association is an administrative body for the voluntary certification of backflow assembly testers. The Association provides annual certificate and member services, offers certification exams, sells manuals, and works with cross-connection control training institutions and community programs.[58]

Backflow assembly tester certification is limited to testing backflow prevention assemblies, whereas cross-connection control inspector certification also includes identifying new or existing cross-connections within a facility by conducting a comprehensive cross-connection risk assessment on drinking water systems.[58]

The Association maintains a community cross-connection control program directory on its website, which lists water purveyors and local governments that have a cross-connection control program. In the fall of 2022, 49 purveyors and/or local governments were listed in the directory; 55 were listed in the fall of 2017.[59]

Recommendation 19a:
Lead in Drinking Water (Schools)

Establish a consistent sampling and reporting protocol for lead in drinking water for schools to follow. Continue to develop plans to implement measures to effectively reduce lead in school drinking water.

Leads: *Ministry of Health, Ministry of Education, regional health authorities*

Progress and Next Steps

This recommendation is **complete.**

HLTH, the Ministry of Education—now called the Ministry of Education and Child Care—and the regional health authorities have developed guidelines and policies that schools can use to sample, manage, and report on lead in school drinking water. Since 2017/2018, the Ministry of Education and Child Care has made funding available to schools for plumbing upgrades. The Ministry prescribes that school districts collect data and work with their regional health authorities to analyze and provide funding to remediate systems as necessary.

The following provides additional information on activities undertaken by HLTH, the Ministry of Education and Child Care, and the regional health authorities in response to this recommendation.

Guidelines on Evaluating and Mitigating Lead in Drinking Water Supplies, Schools, Child Care Facilities and Other Buildings

In April 2019, HLTH updated the *Drinking Water Officers' Guide*[54] to include the *Guidelines on Evaluating and Mitigating Lead in Drinking Water Supplies, Schools, Child Care Facilities and Other Buildings*.[5,57] HLTH and the PHO also provided guidance to the Ministry of Education and Child Care on sampling and reporting protocols.[5]

Testing Lead Content in Drinking Water of School Facilities

The Ministry of Education and Child Care introduced the *Testing Lead Content in Drinking Water of School Facilities*[60] policy in September 2016.[61] The policy requires school districts and independent schools to complete lead content testing in school drinking water every three years for all school facilities within their scope.[61] School districts must submit annual test results to the Ministry by March 30.[61] Public school districts and independent schools work closely with regional health authorities on this initiative.[61] For example, school districts collaborate with regional health authorities on developing water quality testing programs, mitigation strategies, and communication and reporting.[61]

The Ministry of Education and Child Care receives lead content test results for drinking water from all school districts (n = 60), which includes all active school facilities in the province.[61] The lead content testing policy states that each school facility must test taps used for drinking water at least once every three years. In cases

where lead content exceedances have occurred, school districts have worked with regional health authorities to implement mitigation strategies, such as flushing, deactivating taps, installing filtration systems, and/or making plumbing upgrades.[61]

Currently, a centralized data collection and reporting process is in place. Each school district completes a facility report, which lists all the public schools within that district and includes an inventory of the taps tested for lead, the results of those tests, and any mitigation strategies that have been implemented. This report is submitted to the Ministry's Capital Management Branch for analysis. However, due to irregularities in how the data are collected and reported, the results are not easily comparable, which makes determining compliance with the policy difficult. The Capital Management Branch is making improvements to the process for future reporting periods.

Funding for School Plumbing Upgrades

In support of the policy goal, the Ministry of Education and Child Care has prioritized capital funding for plumbing upgrades through the Annual Facility Grant[g] and School Enhancement Program.[61,h] Since fiscal year 2017/18, the Ministry has invested more than $26 million in plumbing upgrades in public school districts.[61] The Ministry and school districts will continue to seek opportunities to improve plumbing systems, including to address any deficiencies identified by the lead testing regimes.[61]

Health Authority Support of School Districts

The regional health authorities have helped school districts develop plans to evaluate lead risks in schools,[40,41,42] implement water quality testing programs,[40] and interpret test results,[38,42] and have provided advice on mitigation strategies and communication,[40] and reporting protocols. Some of the regional health authorities have assigned a specialist or designate environmental health officer to communicate with all schools and school districts on lead issues within their health region.[39]

Recommendation 19b:
Lead in Drinking Water (Child Care Facilities)

Develop plans to promote screening for, and implement measures to effectively reduce levels of, lead in the drinking water of child care facilities, recognizing that children under the age of six are the most vulnerable to the harmful effects of lead.

Leads: *Ministry of Health, regional health authorities*

Progress and Next Steps

This recommendation is **complete.**

The following provides additional information on activities undertaken by HLTH and the regional health authorities in response to this recommendation.

Guidelines on Evaluating and Mitigating Lead in Drinking Water Supplies, Schools, Child Care Facilities and Other Buildings

In April 2019, HLTH updated the *Drinking Water Officers' Guide*[54] to include the *Guidelines on Evaluating and Mitigating Lead in Drinking Water Supplies, Schools, Child Care Facilities and Other Buildings*.[5,57] That same year, the regional health authorities committed to sampling water in all daycares in the province to evaluate risks of lead in drinking water.[5] HLTH continues to support the regional health authorities in this work.[5]

Maintenance Fund Emergency Repair and Replacement

HLTH has worked with the Ministry of Education and Child Care to create a new category of eligibility under the Maintenance Fund Emergency Repair and Replacement[62] program.[63] Through this program, eligible licensed child care providers can apply for funding to help with repairs or to replace items due to emergency circumstances that directly impact children's health and safety and/or may result in immediate facility closure.[63] Beginning in spring 2022, licensed child care facilities in which lead is detected in drinking water may apply to the maintenance fund for reimbursement to cover the cost of one or more National Sanitation Foundation/American National Standards Institute certified faucet-mounted filters to treat lead in their drinking water.[63]

[g] *https://www2.gov.bc.ca/gov/content/education-training/k-12/administration/legislation-policy/public-schools/annual-facility-grant*

[h] *https://www2.gov.bc.ca/gov/content/education-training/k-12/administration/capital/programs#:~:text=The%20School%20Enhancement%20Program%20was,(i.e.%2C%20replacement%2C%20repair)*

Health Authority Support of Child Care Facilities

HLTH and the regional health authorities have developed guidelines and plans to promote screening for, and implement measures to effectively reduce levels of, lead in the drinking water of child care facilities. These measures include but are not limited to:

- Requiring all new child care facilities to provide sample results that indicate that lead levels in their drinking water are safe, as part of their permit application process;
- Providing free water sampling packages to child care licensees or applicants, along with free water sample testing by a qualified laboratory;
- Undertaking lead in drinking water sampling projects; and
- Providing guidance on mitigation measures to the community care facility licensing program to help daycare operators complete their corrective action plans.

In 2021, the First Nations Health Authority began the Run Until Cold campaign, which advised the public that tap water could contain small amounts of lead and copper, which could have long-term health effects on infants and children. The health authority further advised that the risk could be reduced by running cold water for 15–30 seconds before drinking it.[64]

Recommendation 20:
Bulk Water Haulers

Develop provincial guidelines for bulk water haulers to reflect current regulatory requirements and best practices.

Lead: *Ministry of Health*

Progress and Next Steps

No action has been taken on this recommendation.

Due to many competing demands for policy, guideline, and Source-to-Tap Strategy development during this reporting period and to limited policy staff, HLTH has not revised the 1998 Bulk Water Hauling policy pursuant to the former Safe Drinking Water Regulation under the former *Health Act*.

Recommendation 21:
Operator Certification

Ensure that a satisfactory information exchange is occurring between the regional health authorities and the Environmental Operators Certification Program to identify water suppliers who are out of compliance with operator certification requirements.

Lead: *Ministry of Health*

Progress and Next Steps

This recommendation is **complete.**

In 2019/2020, HLTH, the Environmental Operators Certification Program, and the regional health authorities piloted a project to develop a communication process between drinking water system operators, facilities, the Environmental Operators Certification Program, and the regional health authorities.[5] The process was established to help regional health authorities with enforcement of drinking water systems.[5]

The Environmental Operators Certification Program is responsible for the certification of operators and the classification of drinking water systems in BC.[65] It maintains a database of all water supply facilities, including the status of all classified systems and the certification level and status of water system operators.[65] Using this information, the program identifies non-compliant water supply facilities and operators, and contacts the facility owner or operator to notify them of the non-compliance and the steps they can take to correct it.[65] If, after two communications from the program, the facility or operator has not taken any action and continues to be in non-compliance, program staff forward the case to the regional health authority for action.[65]

The Environmental Operators Certification Program and B.C. Regional Health Authorities Communication Process for BC's drinking water supply systems was successfully implemented in June 2020 and was reviewed in 2021.[5] No modifications were required because both the regional health authorities and Environmental Operators Certification Program were satisfied with the process.[5]

Recommendation 22:
Operator Training

Develop a minimum recommended standard of training and competencies for a small water system operator and a bulk water hauler. Standards for small water systems should take into account the varying sizes, levels of complexity, water sources, and governance structures of these small systems.

Leads: *Ministry of Health, regional health authorities*

Progress and Next Steps

No action has been taken on this recommendation.

Although no action has been taken on this recommendation, HLTH and the regional health authorities have supported several capacity-building projects and developed free courses for small water system operators, as described below.

BC Water and Waste Association Small Water Systems Course

In 2019, HLTH provided a contract to the BC Water and Waste Association to develop an online BC Small Water Systems Community Network,[i] including a free course for small water system operators that describes the basics of system ownership and associated responsibilities.[5]

Health Authority Support of Training for Small Water System Operators

Most regional health authorities continue to develop and offer courses for small water systems operators; however, competing demands caused by the COVID-19 pandemic response and the increasing number of climate-related emergencies limited this work during this reporting period.

To assist small water system operators, Interior Health's Drinking Water System program continued to support the development and operation of the BC Small Water Systems Online Help Centre.[j] This project was undertaken in partnership with Thompson Rivers University, Indigenous Services Canada, the Environmental Operators Certification Program, local governments, and industry consultants.[66]

Recommendation 23:
Emergency Response

Ensure all water systems have an appropriate emergency response and contingency plan and have the necessary training and capacity to implement it when needed.

Lead: *Regional health authorities*

Progress and Next Steps

This recommendation is **ongoing.**

The regional health authorities continue to provide guidance to water system operators on the completion of emergency response and contingency plans and on the training operators may need to implement them.

The regional health authorities are taking steps to ensure that all water systems have appropriate emergency response and contingency plans and the necessary training and capacity to implement them. Beginning in 2019/20, each regional health authority was able to report to the PHO on the number and percentage of water systems that had a plan. From 2017/18 to 2020/22, most health authorities reported a slight decline in the percentage of water systems that had appropriate plans. Only Fraser Health reported that all systems in its jurisdiction had completed plans. For more information on water systems that have accepted emergency response and contingency plans, see Section 5.2 (Chapter 5).

Recommendation 24:
Asset Management and Financial Planning

Review training needs and develop guidance for drinking water officers on the required elements of an asset management plan and financial plans for different types of water systems.

Leads: *Ministry of Health, Ministry of Municipal Affairs*

Progress and Next Steps

This recommendation is **in progress.**

In 2019, MUNI and *Asset Management BC*[k] completed the *Asset Management for Sustainable Service Delivery: A BC Framework*.[37,67] The framework provides an overview of the continuous

[i] https://smallwaternetwork.org/

[j] https://smallwatersystemsbc.ca/

[k] https://www.assetmanagementbc.ca/

improvement process of asset management.[37] It identifies the connections between asset condition, level of service, asset management plans, and long-term financial plans.[37] This integration is necessary for sustainable service delivery, and links operation and maintenance costs and capital costs for renewal and growth with available funding (including rates and reserves) to ensure that robust plans are developed to meet the life cycle costs of a service.[37] Asset Management BC offers workshops and training to practitioners throughout the year. Additionally, in 2018, MUNI provided an introductory asset management webinar to drinking water officers.[37]

For more information about the framework, see Section 6.2.2, Chapter 6 in the 2019 PHO report, *Clean, Safe, and Reliable Drinking Water: An Update on Drinking Water Protection in BC and the Action Plan for Safe Drinking Water in British Columbia*.

While the development of the framework represents progress toward this recommendation, drinking water officers require guidance on evaluating water supply system asset management plans or financial plans to determine if the plans have been completed according to the management indicator developed by the PHO. At present, the data systems of the regional health authorities do not track this information.

Recommendation 25: Water Chemistry Data

Develop and resource an action plan and strategy to make water chemistry data for water supply systems from private laboratories available online for reporting and evaluation purposes.

Leads: *Ministry of Health, regional health authorities*

Progress and Next Steps

This recommendation is **in progress.**

HLTH has yet to act on this recommendation, but the regional health authorities are continuing to take steps to make water chemistry data for water supply systems available online. Some regional health authorities manually enter water chemistry data into their database and post chemical analysis reports online. Others track water chemistry data in spreadsheets. No regional health authorities can upload water chemistry data from private laboratories directly into their databases.

The delay in implementing this recommendation is due in part to the different reporting formats used by accredited laboratories and the challenges in reconfiguring regional health authority information systems to receive and report lab water chemistry data. The COVID-19 pandemic response also delayed coordinated action on this recommendation. Work to make water supply system water chemistry data from private laboratories available online for reporting and evaluation purposes should continue as part of the development of the provincial Drinking Water Information System (Recommendation 8b) and water quality data sharing initiatives between agencies (Recommendation 26).

Recommendation 26: Water Quality Data Sharing

Identify effective ways to share water quality monitoring data across agencies with responsibilities in source water protection.

Lead: *Ministry of Environment and Climate Change Strategy*

Progress and Next Steps

This recommendation is **in progress.**

ENV has several projects underway that include sharing water quality monitoring data with agencies that have responsibility for source water protection. In 2021, ENV indicated that additional actions related to water quality monitoring, data, and information will be included in the Watershed Security Strategy.[68] Some of the back-end work to share data across agencies has been completed because data have been uploaded to DataBC under an Open Government Licence since 2018. This will be further enhanced with the completion of the Environmental Monitoring Data System.

The following provides additional information on activities undertaken by ENV in response to this recommendation.

Environmental Monitoring Data System

In April 2020, the Environmental Monitoring Data System project was launched under the Water Information Services Project;[69] a multi-year business transformation initiative that will modernize and improve integration of information systems operated by the Province for managing water resources.[69]

The goal of the Environmental Monitoring Data System project is to replace the Environment Monitoring System (which is used to track the Ministry's environmental monitoring process and contains a wide variety of information on monitoring locations, samples, and results) with a more accessible and user-friendly provincial data system for water and air quality data.[69] It is anticipated that the Environmental Monitoring Data System will have the required functionality to be interoperable with other data systems to enable enhanced sharing of source water quality monitoring data with the Drinking Water Information System module in the Environmental Health Information System.

Recommendation 27:
Access to Approved Laboratories

Develop a strategic approach to support improved access to water testing in remote and rural areas. This includes exploring Level C laboratories and point-of-use testing for microbiological indicators.

Lead: *BC Centre for Disease Control Public Health Laboratory, Enhanced Water Quality Assurance Program*

Progress and Next Steps

This recommendation is **in progress.**

The BC Centre for Disease Control Public Health Laboratory's Enhanced Water Quality Assurance Program has begun work on a strategic approach to support improved access to water testing in remote and rural areas. For example, efforts to address the limited access to laboratory testing in northern BC were piloted in the Northern Health region until the fall of 2020, which were led by the BC Centre for Disease Control Public Health Laboratory.[70] This involved planning and coordinating the establishment of point-of-use testing at select locations, in addition to providing training and consultation for staff.[70]

Additional work conducted by the Enhanced Water Quality Assurance Program included the following:

- **2017:** Studied the possibility of using Level C laboratories for remote sites. Enhanced Water Quality Assurance Program auditor workshop participants decided to rename Level C laboratories as point-of-use testing to better reflect the type of testing being performed. Workshop participants felt that considerable work was needed to develop a point-of-use testing program.[71]
- **2018:** Proposed the use of point-of-use testing and discussed an on-site approval process.[70]
- **2019:** Developed a point-of-use testing project work plan. The point-of-use testing pilot study was impacted by the COVID-19 pandemic. No funding was available to implement it.[70]

In 2020, the Enhanced Water Quality Assurance Program also prepared several draft documents for remote sites that were conducting point-of-use testing, including:

- A health authority application approval checklist
- A readiness checklist
- An Enhanced Water Quality Assurance Program Pre-audit Questionnaire and self-assessment checklist

These documents are under review.[70]

Recommendation 28:
Boil Water Notices

Continue efforts to identify water systems that are on chronic, long-term boil water notices for reasons such as inadequate infrastructure and management, to inform a strategic long-term action plan to support improvements to those systems.

Leads: *Regional health authorities*

Progress and Next Steps

This recommendation is **ongoing.**

The PHO has been working with the regional health authorities to collect information on the number of active and resolved drinking water advisories by the duration of the advisory. These data are reported for the first time in this report for the 2018/19–2021/22 fiscal years.

Most drinking water advisories were resolved within 6 months: more than 50 per cent were resolved within one month, and 20 per cent were resolved within 1–6 months (*Figure 6.8* [Chapter 6]). Thus, most advisories were resolved before the reason for the advisory became systemic.

The overall addition of new advisories to the long-term categories (i.e., advisories that remain in place for more than 18 months) was relatively stable (*Figure 6.9* [Chapter 6]). On March 31, 2019, 226 active advisories had been in place for more than 10 years; the number increased to 253 in 2022. This stability highlights the difficulty in removing long-term advisories from affected water systems.

Recommendation 29: Drinking Water Program Resource Requirements

Review the resources needed by the Ministry of Health, Office of the Provincial Health Officer, and regional health authorities to effectively fulfil their roles under the *Drinking Water Protection Act*.

Leads: *Ministry of Health, Office of the Provincial Health Officer, regional health authorities*

Progress and Next Steps

This recommendation is **in progress.**

In 2020, HLTH was given a mandate to develop a provincial Health Human Resources Strategy to address workforce issues in the health system.[5] Public health workforce needs, including those for drinking water, have been identified as a priority by public health through this work.[5] The Population and Public Health Division, PHO, and regional health authorities were engaged in this work, and feedback will be incorporated into the strategy.[5] *B.C.'s Health Human Resources Strategy: Putting People First*,[l] was released in September 2022; its implementation is ongoing.[72]

Recommendation 30: Training Needs of Persons Acting as Drinking Water Officers

Review the training needs of individuals who are acting as drinking water officers in BC to allow them to carry out program responsibilities under the *Drinking Water Protection Act* and to effectively support water suppliers to achieve clean, safe, and reliable drinking water through the multi-barrier approach.

Leads: *Ministry of Health, Office of the Provincial Health Officer, regional health authorities*

Progress and Next Steps

This recommendation is **in progress.**

The following provides additional information on activities undertaken by HLTH, the PHO, and the regional health authorities in response to this recommendation.

Ministry of Health Review of Drinking Water Officer Training Needs

HLTH is exploring the option of developing micro-credential courses that are focused on drinking water protection to increase the knowledge and skills of environmental health officers who want to work in drinking water.[72] This would provide professional development opportunities for new and experienced environmental health officers and ensure that the environmental health officers who need this training can obtain it.[72]

In fall 2021, HLTH relaunched monthly Drinking Water Leadership Council webinars to support the guidance provided in the *Drinking Water Officers Guide*, and the drinking water officers and others involved in the delivery of safe drinking water.[5]

Health Authority Review of Drinking Water Officer Training Needs

All the regional health authorities have established (or are in the process of establishing) drinking water officer delegation processes to ensure their environmental health officers have sufficient training and experience in drinking water. Drinking water officer training takes many forms, including ongoing, personalized development plans for each environmental health officer, training sessions, webinars, and annual workshops. Because the regional health authorities have taken different approaches to staff training, development of a training framework by HLTH would be helpful.

[l] https://news.gov.bc.ca/files/BCHealthHumanResourcesStrategy-Sept2022.pdf.

Recommendation 31:
Investigating Threats to Drinking Water

Develop guidance for investigating threats to drinking water under section 29 of the *Drinking Water Protection Act*. These guidelines should clarify the scope of section 29 investigations where assessments are required outside of the capacity of the health authority.

Lead: *Ministry of Health*

Progress and Next Steps

This recommendation is **in progress.**

The *Drinking Water Officers Guide* includes basic guidance on what information should be included in a request for an investigation under section 29. The guide was updated in 2014 with a *Requests for Investigation of a Drinking Water Threat under the Drinking Water Protection Act*[73] section, which includes a form for regional health authorities to use or adapt for people who believe there is a threat to their drinking water and who request an investigation. The template contains a sample questionnaire for investigations, which includes what information to provide to a drinking water officer. While this additional section of the guide provides helpful information about the request process and information requirements, it does not include any further information on what steps drinking water officers must take as part of their investigation of a potential threat when the threat or source of contamination cannot be readily identified without further sampling or assessments.

RECOMMENDATION 32:
Tracking of Activities under the *Drinking Water Protection Act*

Develop a consistent and reliable method for tracking drinking water program activities under the *Drinking Water Protection Act*, including inspections, investigations, enforcement actions, reconsideration of decisions, and drinking water officer engagement and interactions with water suppliers, operators, local governments, and the public.

Leads: *Regional health authorities*

Progress and Next Steps

This recommendation is **in progress.**

While some regional health authorities have modified their databases to improve tracking and reporting of activities under the *Drinking Water Protection Act*, and others have developed tracking systems such as forms and spreadsheets to help monitor activities such as inspections and investigations, this recommendation will not be completed until the regional health authorities have established and adopted common business processes and HLTH has implemented the Drinking Water Information System.

Drinking Water Information System

Information about the Drinking Water Information System is provided under Recommendation 8b in this chapter.

REFERENCES

[1] Drinking Water Protection Act [SBC 2001, c.9] [statute on the Internet]; [cited 2022 Dec 9]. Available from: *http://www.bclaws.ca/civix/document/id/complete/statreg/01009_01*.

[2] BC Office of the Provincial Health Officer. Clean, safe, and reliable drinking water: an update on drinking water protection in BC and the action plan for safe drinking water in British Columbia 2019. [Internet]. Victoria, BC: BC Office of the Provincial Health Officer; 2019 [cited 2021 Nov 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/pho-drinking-water-report-2019.pdf*.

[3] BC Ministry of Health Planning, BC Ministry of Health Services. Action plan for safe drinking water in British Columbia. [Internet]. Victoria, BC: BC Ministry of Health Planning, BC Ministry of Health Services; 2002 [cited 2022 Apr 25]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/safe_drinking_printcopy.pdf*.

[4] BC Office of the Auditor General. The protection of drinking water: an independent audit report. [Internet]. Victoria, BC. BC Office of the Auditor General; 2019, Jul [cited 2022 Apr 21]. Available from: *https://www.bcauditor.com/sites/default/files/publications/reports/OAGBC_Protection-of-Drinking-Water_RPT.pdf*.

[5] BC Ministry of Health. Response to request for data in support of the PHO report [email from M Om Prakash]; 2022 Apr 12.

[6] Econics. Review of source water protection mandates [unpublished]. Victoria, BC: BC Ministry of Health; 2021 Feb 12.

[7] Dale E. Personal communication. Ministry of Health; 2022 Dec 12.

[8] BC Ministry of Environment and Climate Change Strategy. Key messages: watershed security strategy and fund; [unpublished]. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; 2022 Jan 20.

[9] Pinches, C. Personal communication. BC Ministry of Land, Water and Resource Stewardship; 2023 Aug 30.

[10] BC Water Committee. Terms of reference. Victoria, BC: Government of British Columbia; 2022.

[11] McKee, M. Personal communication. BC Ministry of Land, Water and Resource Stewardship; 2022 Aug 24.

[12] Water Policy and Legislation Committee. Terms of reference. Victoria, BC: Government of British Columbia; 2022.

[13] BC Ministry of Environment and Climate Change Strategy. Response to request for data in support of the PHO report [email from J Mack]; 2022 Feb 22.

[14] Forest and Range Practices Act [SBC 2002, c.69] [statue on the Internet]; cited 2022 Dec 15. Available from: *https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/02069_01*.

[15] Government of British Columbia. Forest and Range Practices Act [Internet]. Victoria, BC: Government of British Columbia; [cited 2022 Dec 12]. Available from: *https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/legislation-regulation/forest-range-practices-act*.

[16] BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Forest and Range Practices Act improvement initiative: renewal and resilience discussion paper. Victoria, BC: BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development; 2019 [cited 2022 Dec 12]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/frpa/discussion_paper_frpa.pdf*.

[17] BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. What we heard: Forest and Range Practices Act improvement initiative: renewal and resilience. Victoria, BC: BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development; 2019 [cited 2022 Dec 12]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/frpa/frpa_wwh.pdf*.

[18] BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. What we heard from Indigenous Nations Forest and Range Practices Act improvement initiative: renewal and resilience. Victoria, BC: BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development; 2019 [cited 2022 Dec 12]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/frpa/frpa_wwh_indigenous_nations.pdf*.

[19] Bill 21 – 2019. Forest and Range and Practices Amendment Act, 2019 [statue on the Internet]; cited 2022 Dec 15. Available from: *https://www.bclaws.gov.bc.ca/civix/document/id/bills/billsprevious/4th41st:gov21-3*.

[20] BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Modernizing forest policy in British Columbia: setting the intention and leading the forest sector transition. Victoria, BC: BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development; 2021 [cited 2022 Dec 12]. Available from: *https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/competitive-forest-industry/modernizing_forestry_in_bc_report.pdf*.

[21] BC Ministry of Environment and Climate Change Strategy. Towards livestock watering regulations under British Columbia's Water Sustainability Act. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; 2018 [cited 2022 Dec 12]. Available from: *https://engage.gov.bc.ca/app/uploads/sites/71/2018/01/Livestock_Watering_Regs_intentions_paper.pdf*.

[22] BC Ministry of Environment and Climate Change Strategy. Proposed Livestock Watering Policy under British Columbia's Water Sustainability Act. What we heard on livestock watering. Victoria BC, BC Ministry of Environment and Climate Change Strategy; 2019 [cited 2022 Dec 12]. Available from: *https://engage.gov.bc.ca/app/uploads/sites/71/2019/10/What-We-Heard_public_FINAL4.pdf*.

[23] BC Ministry of Environment and Climate Change Strategy. Update on proposed livestock watering policy under British Columbia's Water Sustainability Act. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; 2020 [cited 2022 Dec 12]. Available from: *https://engage.gov.bc.ca/app/uploads/sites/71/2020/07/Update-on-Proposed-Livestock-Watering-Policy.pdf*.

[24] Organic Matter and Recycling Regulation [statute on the Internet]; [cited 2022 Dec 12]. Available from: *https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/35_18_2002*.

[25] BC Ministry of Environment and Climate Change Strategy. Organic matter recycling regulation policy intentions paper. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; 2018 [cited 2022 Dec 12]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/waste-management/organic-waste/reports-and-papers/2018_omrr_intentions_paper.pdf*.

[26] BC Ministry of Environment and Climate Change Strategy. Organic Matter Recycling Regulation project update. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; 2022 Jun [cited 2022 Dec 12]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/waste-management/organic-waste/reports-and-papers/omrr-public-update-june-2022.pdf*.

[27] Environmental Management Act Code of Practice for Agricultural Environmental Management. [statute on the Internet]; [cited 2022 Dec 12]. Available from: *https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/8_2019*.

[28] BC Ministry of Environment and Climate Change Strategy. Agricultural environmental management. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; [cited 2022 Dec 12]. Available from: *https://www2.gov.bc.ca/gov/content/environment/waste-management/industrial-waste/agriculture#:~:text=The%20Code%20of%20Practice%20for,and%20materials%20on%20agricultural%20operations*.

[29] BC Ministry of Environment and Climate Change Strategy. Nutrient management planning. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; [cited 2022 Dec 12]. Available from: *https://www2.gov.bc.ca/gov/content/environment/waste-management/industrial-waste/agriculture/regulation-requirements/nmp-under-aemcop*.

[30] Rekken G. Personal communication. Ministry of Agriculture; 2023 Aug 16.

[31] BC Ministry of Environment and Climate Change Strategy. Fact sheet: interim considerations for landfills accepting contaminated soils. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; 2021 Mar [cited 2022 Dec 12]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/waste-management/garbage/gui-tec-04_landfilling_contaminated_soil_factsheet.pdf*.

[32] BC Ministry of Environment and Climate Change Strategy. Landfill criteria for municipal solid waste. Second edition. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; 2016 [cited 2022 Dec 12]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/waste-management/garbage/landfill_criteria.pdf*.

[33] BC Ministry of Environment and Climate Change Strategy. Guidelines for environmental monitoring at municipal solid waste landfills. Victoria, BC: BC Ministry of Environment and Climate Change Strategy; [cited 2023 Nov 28]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/waste-management/garbage/guidelines_environmental_monitoring_municipal_solid_waste_landfills.pdf*.

[34] Richardson, K. Personal communication. BC Ministry of Environment and Climate Change Strategy; 2023 Aug 09.

[35] BC Ministry of Energy, Mines and Low Carbon Innovation. Scientific review of hydraulic fracturing in British Columbia. Victoria, BC: BC Ministry of Energy, Mines and Low Carbon Innovation; 2019 Feb [cited 2023 Nov 28]. Available from: h*ttps://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-gas-oil/responsible-oil-gas-development/scientific_hydraulic_fracturing_review_panel_final_report.pdf*.

[36] BC Oil and Gas Commission. Response to request for data in support of the PHO report [email from I Piccinino]; 2022 Mar 21.

[37] BC Ministry of Municipal Affairs. Response to request for data in support of the PHO report [email from B Bedford]; 2022 May 16.

[38] Vancouver Coastal Health Authority. Response to request for data in support of the PHO report [email from M Ritson]; 2022 Apr 20.

[39] Interior Health Authority. Response to request for data in support of the PHO report [email from S Pollock]; 2022 Apr 21.

[40] Fraser Health Authority. Response to request for data in support of the PHO report [email from B Choquette]; 2022 Apr 19.

[41] Island Health Authority. Response to request for data in support of the PHO report [email from C Diplock]; 2022 Apr 20.

[42] Northern Health Authority. Response to request for data in support of the PHO report [email from S Wadden]; 2022 Apr 26.

[43] Ospan, S. Personal communication. BC Ministry of Health; 2023 Aug 02.

[44] BC Ministry of Forests. Response to request for data in support of the PHO report [email from J Shah]; 2022 May 16.

[45] BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Guide to applying for a Certificate of Public Convenience and Necessity (CPCN) [Internet]. Victoria, BC: BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development; 2016 Nov [cited 2022 Jun 14]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-licensing-and-rights/water-utilities/application_guide_certificate_of_public_convenience.pdf*.

[46] BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Design guidelines for rural residential community water systems. [Internet]. Victoria, BC: BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development; 2012 [cited 2023 Nov 28]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-licensing-and-rights/water-utilities/design_guidelines_rural_residential_water_mar2012.pdf*.

[47] BC Ministry of Municipal Affairs. Response to request for data in support of the PHO report [email from B Bedford]; 2022 May 16.

[48] BC Ministry of Transportation. Response to request for data in support of the PHO report [email from I Pilkington]; 2022 July 28.

[49] Government of British Columbia. Investing in Canada Infrastructure Program - British Columbia - Green Infrastructure - Environmental Quality. [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 Nov 28]. Available from: *https://www2.gov.bc.ca/gov/content/transportation/funding-engagement-permits/funding-grants/investing-in-canada-infrastructure-program/green-infrastructure/environmental-quality*.

[50] BC Ministry of Forests. Response to request for data in support of the PHO report [email from C Chapman]; 2022 Aug 02.

[51] Government of Canada. Investing in Canada Infrastructure Program. [Internet]. Ottawa. ON: Government of Canada; [cited 2023 Nov 28]. Available from: *https://www.infrastructure.gc.ca/plan/icp-pic-INFC-eng.html*.

[52] BC Ministry of Health. Guidelines for pathogen log reduction credit assignment. [Internet]. Victoria, BC: BC Ministry of Health; 2022 [cited 2022 May 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/dwog_part_b_-_15_pathogen_log_reduction_credit_assignment.pdf*.

[53] BC Ministry of Health. Guidelines for ultraviolet disinfection of drinking water. [Internet]. Victoria, BC: BC Ministry of Health; 2022 [cited 2022 May 18]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/dwog_part_b_-_16_ultraviolet_disinfection_of_drinking_water.pdf*.

[54] C Ministry of Health. Drinking water officers' guide. [Internet]. Victoria, BC: BC Ministry of Health; 2023 Mar 23 [cited 2023 Oct 31]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/drinking_water_officers_guide_-_consolidated.pdf*.

[55] BC Ministry of Health. Design guidelines for drinking water systems in British Columbia. [Internet]. Victoria, BC: BC Ministry of Health; 2023 Mar [cited 2023 Oct 28]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_b_-_17_design_guidelines_for_drinking_water.pdf*.

[56] BC Ministry of Health. British Columbia guidelines (microbiological) on maintaining water quality in distribution systems. Version 1.2. [Internet]. Victoria, BC: BC Ministry of Health; 2016 Nov [cited 2022 Sep 09]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_b_-_7_secondary_disinfection.pdf*.

[57] BC Ministry of Health. Drinking water officers' guide. Guidelines on evaluating and mitigating lead in drinking water supplies, schools, child care facilities and other buildings. [Internet]. Victoria, BC: BC Ministry of Health; 2019 [cited 2022 Aug 31]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_b_-_12_evaluating_and_mitigating_lead.pdf*.

[58] BC Water and Waste Association. Cross-connection control [Internet]. Burnaby, BC: BC Water & Waste Association; [cited 2019 Feb 04]. Available from: *https://www.bcwwa.org/site/ccc/cross-connection-control?nav=sidebar*.

[59] BC Water and Waste Association. Vancouver, BC: BC Water and Waste Association. [Cited 2022 Dec 9] Available from: *https://bcwwa.org/site/ccc/programs?nav=sidebar*.

[60] BC Ministry of Education and Child Care. Testing lead content in drinking water of school facilities. [Internet]. Victoria, BC: BC Ministry of Education and Child Care. [cited 2023 Nov 28]. Available from: *https://www2.gov.bc.ca/gov/content/education-training/k-12/administration/legislation-policy/public-schools/testing-lead-content-in-drinking-water*.

[61] BC Ministry of Education and Child Care. Response to request for data in support of the PHO report [email from C Brown]; 2022 Jun 28.

[62] Government of British Columbia. Maintenance Fund Emergency Repair and Replacement. [Internet]. Victoria, BC: Government of British Columbia; [cited 2023 Nov 28]. Available from: *https://www2.gov.bc.ca/gov/content/family-social-supports/caring-for-young-children/running-daycare-preschool/childcare-bc-maintenance-fund/emergency-repair-replacement*.

[63] Kot M. Personal communication. BC Ministry of Health, Health Protection Branch; 2022 Dec 5.

[64] First Nations Health Authority. Run until cold. [cited 2022 Dec 13]. Available from: *https://www.fnha.ca/Documents/FNHA-EPHS-Run-until-Cold-2.pdf*.

[65] Environmental Operators Certification Program. Environmental Operators Certification Program (EOCP) and BC Health Authorities Communication Process for Drinking Water Supply Systems: 2020 June [cited 2022 July 11]. Available from: *https://eocp.ca/wp-content/uploads/2020/07/HA_EOCP-Communication-Process-Communique.pdf*.

[66] Interior Health Authority. Response to request for updates to the status of drinking water in British Columbia 2021 [email from JI Norlin]; 2021 Sep 07.

[67] Asset Management BC. Asset management for sustainable service delivery: a BC framework. [Internet]. Asset Management BC. 2019 [cited 2023 Nov 28]. Available from: *https://www.assetmanagementbc.ca/wp-content/uploads/Asset-Management-for-Sustainable-Service-Delivery-A-BC-Framework-.pdf*.

[68] BC Ministry of Environment and Climate Change Strategy. Response to request for data in support of the PHO report [email from J Mack]; 2022 Mar 22.

[69] BC Ministry of Environment and Climate Change Strategy. Environmental Monitoring Data System (EnMoDS) Project October 2022 update [email from L Nash]; 2022 Nov 1.

[70] BCCDC Public Health Laboratory. Response to request for data in support of the PHO report [email from C Lee]; 2022 Jul 07.

[71] BC Ministry of Environment and Climate Change Strategy. Environmental Monitoring Data System (EnMoDS) Project October 2022 update [email from L Nash]; 2023 Jan 25.

[72] Massey K and Wardle J. Personal communication. Ministry of Health: 2022 Dec 13.

[73] BC Ministry of Health. Drinking Water Officers' Guide 2022 – Part B: Section 2. Requests for investigation of a drinking water threat under the Drinking Water Protection Act. [internet]. Victoria, BC: BC Ministry of Health; 2022 [cited 2023 August 23]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/how-drinking-water-is-protected-in-bc/dwog_part_b_-_2_investigation_of_a_threat.pdf*.

The Sunshine Coast Regional District uses siphons to access emergency drinking water storage when water in Chapman Lake no longer flows naturally into Chapman Creek, 2022.

Photo credit: Sunshine Coast Regional District.

PART 7:

Discussion and Recommendations

Part 7 (Chapter 12) provides a discussion of findings from April 1, 2017 to March 31, 2022 and a summary of where progress was made in improving drinking water in BC and where challenges remain. The chapter also presents 20 new recommendations to advance drinking water quality and protection across BC.

CHAPTER

12 Discussion and Recommendations

The Provincial Health Officer (PHO) has responsibility under section 4.1 of the *Drinking Water Protection Act* (DWPA) to report on activities under the Act. Previous reports have tracked progress toward the *Action Plan for Safe Drinking Water in British Columbia* (the Action Plan). This report continues the transition in how the PHO is reporting on drinking water in BC. It incorporates new indicators and water system categories developed by the Office of the Provincial Health Officer, Ministry of Health (HLTH), and regional health authorities. These new indicators align with the key elements of a multi-barrier approach for drinking water protection and will reflect the progress being made in BC to protect drinking water.

The 2019 PHO drinking water report *Clean, Safe, and Reliable Drinking Water: An Update on Drinking Water Protection in BC and the Action Plan for Safe Drinking Water in British Columbia* provided an update on progress on the Action Plan and an overview of activities conducted under the DWPA for fiscal years 2012/13–2016/17. This report describes the activities conducted under the Act during the 2017/18–2021/22 fiscal years, presents a summary of the impacts of the COVID-19 pandemic and extreme climate-related events over the reporting period on the drinking water program and water suppliers, and provides an update on the status of recommendations made in the last report.

More than four years have passed since the release of the last report, and in that time, the province and the drinking water program have been affected by a global pandemic, supply chain shortages, and catastrophic floods and other climate-related events such as droughts, wildfires, extreme heat, and cold temperatures. Each of these emergencies has created challenges for drinking water suppliers and those responsible for the protection of drinking water. Despite these challenges, the Province has made progress on several of the recommendations in the last report.

12.1 Summary of Progress for Safe Drinking Water in British Columbia

12.1.1 Areas of Progress

The Province made progress on advancing 25 of the 32 recommendations in the 2019 PHO drinking water report: six recommendations were completed, 14 are in progress, and five are ongoing.

Most notably, the Province completed two of three priority recommendations pertaining to the governance of drinking water and made progress on the third. HLTH completed a review of the existing governance structure for drinking water protection, specifically source water protection, and made recommendations to government for a new governance model. This work helped inform the restructuring of the natural resource ministries, which led to the creation of the Ministry of Water, Land and Resource Stewardship (WLRS) in 2022. WLRS was assigned the mandate for source water protection and for providing leadership on, and coordination of, the development of a new Source-to-Tap Strategy for drinking water in BC.

In 2021, prior to the creation of WLRS, HLTH began developing a project plan for, and began engagement on, a new strategic plan for safe drinking water. The plan was intended to replace the 2002 Action Plan. Since the announcement of the new ministry, staff from HLTH and WLRS have been working closely to transition this work and develop an interagency plan for the protection of drinking water.

During this reporting period, the Province established several executive-level committees to facilitate broader interagency collaboration and coordination on drinking water; they include the Executive Directors Steering Committee on Drinking Water, BC Water Committee, and the Assistant Deputy Minister Water Forum. Other notable interagency committees include the Water Policy and Legislation Committee, the Clcahl/Hullcar Steering Committee, the Inter-Agency Drought Working Group, and the Flood Water Quality Monitoring Task Force established to respond to the 2021 floods.

WLRS is also leading the development of the Watershed Security Strategy, which intends to build on, align with, and complement the current work across government to help ensure BC's watersheds are healthy.[1] For more information on the strategy, see Section 3.2.1 (Chapter 3).

The 2019 PHO drinking water report called for a review of legislation and legislative tools for source water protection. During this reporting period, the Province made progress on this recommendation. Most notably, HLTH completed a review of all statutes and regulations that impact source water, and began a review of drinking water protection plans.

HLTH also made progress on creating new, and updating existing, technical guidance documents. The guidelines in these documents are used by public health professionals, water suppliers, drinking water professionals, regulatory agencies, and other interested parties and partners in BC who are involved in the design, construction, and approval of drinking water systems. The guidelines help ensure that water treatment and distribution system infrastructure meet provincial requirements for the provision of safe, clean, and reliable drinking water. They provide clear guidance that will help improve the efficiency and consistency of the design, review, and approval processes for the construction of new drinking water systems and for making changes to existing systems. The guidelines also build on leading practices in BC, incorporate applicable standards from other jurisdictions, and reflect the diversity of water systems that serve communities across the province. New additions to the *Drinking Water Officers' Guide* in 2022 included the *Guidelines for Ultraviolet Disinfection of Drinking Water* and the *Guidelines for Pathogen Log Reduction Credit Assignment*. The *Design Guidelines for Drinking Water Systems in British Columbia, Guide to Emergency Response and Contingency Plans for Water Supply Systems*, and *Guide for Communicating with Water Users* were released in 2023 during the development of this report.

Other guidelines released and updated for inclusion in the *Drinking Water Officers' Guide* during this reporting period include the *Guidelines on Evaluating and Mitigating Lead in Drinking Water Supplies, Schools, Child Care Facilities and Other Buildings* and *Guidance on Manganese in Drinking Water*. Both documents provide detailed information on exposure and toxicity, and procedures on how to evaluate and mitigate risk.

Schools across BC continue to sample for lead in drinking water as per policies set by the Ministry of Education and Child Care. During this reporting period, the regional health authorities committed to sampling drinking water in all licensed child care facilities to screen for elevated levels of lead. To support this work, HLTH and the Ministry of Education and Child Care created the Maintenance Fund Emergency Repair and Replacement; eligible child care centres can apply for funding to help cover the costs of one or more National Sanitation Foundation/American National Standards Institute certified faucet-mounted filters for the treatment of lead in drinking water.[2]

The previous PHO drinking water report described a new indicator project and the work done in partnership by the PHO, regional health authorities, and HLTH. This involved modifying regional health authority data systems to capture the new information on the indicators, and training environmental health officers and support staff in data quality assurance and control procedures. This work will standardize data collection and reporting to the PHO and will provide a holistic view of the Province's progress in implementing a multi-barrier approach. While not all the indicators can be reported on, some progress has been made regarding water system types, advisory reporting, source assessments and protection plans, groundwater assessments, and annual reporting. The Environmental Health Information System project under development by HLTH will further support and enhance the PHO indicator project and the PHO's ability to access standardized data in a timely manner.

12.1.2 Areas of Challenge

Despite the progress made, many of the gaps identified in previous progress reports on the *Action Plan for Safe Drinking Water in British Columbia* persist.

Managing and collecting information on drinking water and source supplies continues to be challenging. Work is ongoing within regional health authorities to either adapt their data systems to collect information on the indicators introduced in the previous PHO drinking water report or switch to a more robust platform. The investigation into developing a Drinking Water Information System within the new provincial Environmental Health Information System has been driven in part by gaps in regional health authority processes, data storage issues, and a lack of support from current platform vendors. Additionally, four of five regional health authorities have data systems that are nearing their end of life.[3] As a result, until the health authorities adapt their data systems or switch to the more robust Environmental Health Information System currently under development, the capacity to report on activities remains limited.

At both the regional health authority and provincial levels, resources for abatement and enforcement programs to protect drinking water and source water are insufficient; this creates challenges in fulfilling the Province's mandate to protect drinking water. The number of water systems compared to the number of full-time equivalent environmental health officers is considerable (155 water systems per environmental health officer), and trends indicate that this disparity will continue to grow. Additionally, staff at regional health authorities have been redeployed to the COVID-19 pandemic response and to support communities and water suppliers during climate-related emergencies. This has impacted regional health authority drinking water programs because staff are spread across program areas, which has led to gaps in routine work. Regional health authorities also face substantial obstacles in filling job vacancies due to staff, especially in rural areas, relocating to other regions/positions, and to retirements. Given the importance of having clean, safe, and reliable drinking water, and the increasing complexity of, and demands on, drinking water protection programs across the province, a strategic review of drinking water program priorities and the development of new initiatives may be required to support regional health authorities in having adequate staffing levels.

Although the pandemic impacted staffing, the drinking water program has been poorly resourced for decades, as outlined in the 2019 PHO drinking water report. Since the initial investment in drinking water officer positions after the proclamation of the DWPA, the number of full-time equivalent positions for drinking water has decreased while the number of water systems continues to grow, a situation made more dire in the face of increasing climate-related disasters.

The Ministry of Health's Population and Public Health Division is leading the Strengthening Public Health Initiative, in consultation with the PHO and regional health authorities. The intent of the Strengthening Public Health Initiative is to create a renewed provincial *Guiding Framework for Public Health*, supported by an Action Plan with population health baseline data and indicators, as well as system performance measures and population health measures. Together, these documents are intended to provide clear and strategic direction to the BC public health system, and promote accountability and transparency.[4]

The COVID-19 pandemic had many unanticipated consequences, including impacts on regional health authority drinking water programs and water suppliers in BC. The impacts included regional health authority and water supplier staffing shortages; difficulties in collecting, transporting, and analyzing drinking water samples; and reductions in drinking water system inspections.

The regional health authorities and other agencies with responsibilities in drinking water protection adopted various strategies to minimize the impact of the COVID-19 pandemic on drinking water systems, such as arranging alternative courier networks to transport water samples, using point-of-use testing of water samples in remote areas that do not have laboratory access, and establishing an online Help Centre for small water systems. While 80 per cent of surveyed water system operators did not feel that the changes in operations due to COVID-19 would have long-term implications for their facilities, regional health authority drinking water program staff pointed out that the backlog in inspections and environmental health officer staffing shortages would challenge their drinking water programs and their ability to meet the PHO recommendation for reporting by 2024.

The unprecedented floods, wildfires, drought, and heat events that occurred during this reporting period highlighted the challenges communities, water suppliers, laboratories, and drinking water officers face when extreme climate-related events occur. These events stressed supply chains and laboratory transportation networks, and limited the availability of regional health authority staff to conduct routine work because they were responding to these emergencies. Impacted water suppliers suffered extensive and costly damage to their systems, which required assessments and assistance that exceeded their capacity to manage. These events demonstrated the clear need for ongoing and further climate resilience, preparedness, and disaster response planning and coordination for drinking water so that drinking water officers, water suppliers, local governments, First Nations, laboratories, and the Province are better equipped to respond to climate-related events. Officials identified mutual aid agreements, mapping of critical infrastructure, and clarity in processes for accessing funds for recovery as tools to better support drinking water suppliers in responding to climate-related disasters.

The number of small water systems in BC continues to grow, which places increasing strain on regional health authorities, local governments, and partner ministries. Many of these systems have limited financial and operational capacity to maintain aging infrastructure and address any regulatory deficiencies in order to meet increasingly stringent drinking water quality guidelines. These issues are difficult to resolve because more expensive equipment or treatment and extensive knowledge and training are often required. Small water systems have opportunities to merge with other small systems or to be acquired by local governments in order to overcome issues with infrastructure, water quality, or governance. Unfortunately, local government moratoriums, differing opinions on ownership, treatment, and how costs should be shared, and resistance to increased water rates often cause systems that explore acquisition and/or amalgamation to fail in that endeavour.

This report also documented an increasing trend in the number of drinking water advisories issued since the last PHO drinking water report, particularly within Interior Health and Northern Health. The 803 total advisories recorded as of March 31, 2022 is the highest number ever recorded and represents a 2 per cent increase in the total number of systems on advisory since 2018. Although the number of water systems increased slightly during this period, this does not appear to be the main driver of the increase in advisories. While most advisories are resolved and removed within six months of their issuance, the number of systems that have remained on advisory for more than five years continues to creep upward. On March 31, 2022, 7 per cent (*n* = 345) of all water systems had been on an advisory for more than five years. This reflects the increasing challenges that some smaller water suppliers face due to inadequate and aging treatment and distribution infrastructure, coupled with limited financial and management capacity—challenges that are compounded by climate change and associated extreme weather events. The First Nations Health Authority also recorded more new advisories during 2021/22 than in previous years, but more advisories were resolved than were issued. As of March 31, 2022, there were no long-term advisories for community water systems funded by Indigenous Services Canada on First Nations reserve lands.

12.2 Recommendations: Setting Strategic Priorities for Drinking Water Protection

Most residents of BC consistently enjoy clean, safe, reliable drinking water; however, more can be done to improve the protection of drinking water from source to tap, particularly for small water systems that are not owned or operated by a local government. While the Province made progress in advancing many of the recommendations from the 2019 PHO drinking water report, 14 recommendations remain in progress, and no action has been taken on seven other recommendations.

The following 20 recommendations are offered to advance drinking water quality and protection across BC. Fifteen are refreshed updates to recommendations made in the 2019 PHO drinking water report that were in progress or outstanding at the time this report was written; five are new. The status of each recommendation (new or refreshed from the 2019 report) is indicated, along with the lead organization

responsible for the recommendation. While some recommendations have a clear provincial ministry or agency lead, others will require co-leadership and/or cross-ministry and cross-agency partnerships and collaboration.[a]

- Recommendations 1 and 2 pertain to the continued development of a new Source-to-Tap Strategy and the governance of drinking water protection.
- Recommendations 3 through 8 suggest actions to improve legislative and policy frameworks to protect drinking water.
- Recommendations 9 through 11 seek to improve available data to strengthen program oversight and evaluation.
- Recommendations 12 and 13 provide recommendations regarding small water systems, including a call for a small water system strategy as part of a Source-to-Tap Strategy for drinking water.
- Recommendations 14 and 15 call for actions to strengthen resources for the provincial drinking water protection program.
- Recommendations 16 through 20 provide recommendations for developing specific guidance to include in the *Drinking Water Officers' Guide*.

Priority recommendations for government include developing a provincial Source-to-Tap Strategy (Recommendation 1) that includes a small water system strategy (Recommendation 12), completing a provincial interoperable data system for drinking water (Recommendation 10), addressing emergency response planning and climate change resilience for drinking water (Recommendations 5 and 6), ensuring that drinking water protection programs are adequately resourced (Recommendation 15), and reviewing and modernizing the DWPA and source water protection tools (Recommendations 3, 4, and 16).

12.2.1 Governance of Drinking Water Protection

The governance of drinking water and source water supplies in BC is complex and involves many actors federally, provincially, and locally. The decentralized nature of the regulatory structure in BC has led to challenges when competing interests arise, particularly for source water protection. Since the last PHO drinking water report, the Province successfully completed two of three recommendations to improve the governance of drinking water protection, including appointing an agency to be accountable for source water protection, and identifying a new interagency framework for collaboration and coordination that includes public health. Furthermore, the Province created WLRS to provide the leadership needed to coordinate the development of a new Source-to-Tap Strategy to replace the 2002 *Action Plan for Safe Drinking Water in BC*.

Recommendation 1: Action Plan and Memorandum of Understanding

Develop the Source-to-Tap Strategy to replace the *Action Plan for Safe Drinking Water in British Columbia*. Develop a formalized agreement on interagency coordination to replace the 2006 Memorandum of Understanding regarding inter-agency accountability and coordination on drinking water protection, and recommit to modernized principles and actions across government.

Lead: *Ministry of Water, Land, and Resource Stewardship, in collaboration with the Ministry of Health*

Status: *Refreshed – adapted from Recommendation 2 – In Progress*

Recommendation 2: Roles and Responsibilities for Drinking Water on Federal Land

Clarify roles and responsibilities for the oversight of drinking water and the authority of the BC *Drinking Water Protection Act* on federal lands and in federal facilities (e.g., national parks, airports and other ports, border crossings, Royal Canadian Mounted Police detachments, and other federal buildings) to ensure adequate oversight and protection of public health in relation to drinking water.

Lead: *Ministry of Health, in collaboration with the Ministry of Water, Land and Resource Stewardship*

Status: *New*

[a] The "Lead" is the primary ministry, agency, or partner that has responsibility for the program area specified in the recommendation and should report on activities undertaken in support of the recommendation. Any ministry, agency, or partner working in "collaboration" will be supporting the efforts of the Lead, and is not expected to report on activities unless requested to by the Lead.

12.2.2 Legislative and Policy Frameworks to Protect Drinking Water

The Action Plan called for the development of strong, effective legislation with clear lines of responsibility. While 20 years have passed since the release of the Action Plan, this remains a priority, especially given the growing demands and pressures that watersheds and water suppliers are facing. Although much progress has been made in developing new legislation and guidance across BC, further work is needed. During this reporting period, extensive work was conducted to review the legislation and legislative tools for protecting source water. While this work has led to promising changes, further review of the DWPA and its legislative tools is needed. Furthermore, recommendations from the last report remain outstanding, including addressing the conflict pertaining to joint works and the interpretation of who is a water supplier under the DWPA, *Water Sustainability Act*, and *Water Users' Communities Act*, and conducting a review of the public assent processes under the *Community Charter*. Provincial emergencies such as the COVID-19 pandemic and climate-related events during this reporting period also demonstrated the need for further work and planning provincially to address climate resilience and emergency preparedness regarding drinking water protection and delivery.

Recommendation 3:
Legislative Review of the *Drinking Water Protection Act*

Conduct a legislative review of the *Drinking Water Protection Act* to:

Identify amendments to address ongoing small water system challenges, climate change resilience, source water protection, and the Province's commitment to the *Declaration on the Rights of Indigenous Peoples Act*.

Lead: *Ministry of Health, in collaboration with the Ministry of Water, Land and Resource Stewardship*

Status: *New*

Recommendation 4:
Drinking Water Protection Plans

a. Complete a comparative review of planning tools that can assist in drinking water source protection under the *Water Sustainability Act, Drinking Water Protection Act, Environmental Management Act*, and *Forests and Range Practices Act*.

b. Complete a review of the objectives and effectiveness of drinking water protection plans under the *Drinking Water Protection Act* as a water source and system protection tool to determine if changes to the Act could enable more collaborative, proactive, and legally binding protection.

c. After completion of 4.a & 4.b, develop guidance that outlines the criteria for when a drinking water protection plan is appropriate and what steps must be taken by the drinking water officer and Provincial Health Officer before making a recommendation to the Minister.

Lead: *Ministry of Water, Land and Resource Stewardship, in collaboration with the Provincial Health Officer, Ministry of Health, and regional health authorities*

Status: *Refreshed – adapted from Recommendation 5 - In Progress*

Recommendation 5:
Climate Resiliency and Emergency Response

Develop a provincial drinking water disaster preparedness, response, and recovery plan that includes First Nations water suppliers and:

a. Clarifies roles and responsibilities for drinking water during an emergency.

b. Plans for the provision of drinking water in the event of widespread infrastructure damage, loss of water source, severe drought or water scarcity, or widespread contamination that cannot be removed by treatment.

Lead: *Ministry of Water, Land and Resource Stewardship, in collaboration with the Ministry of Emergency Management and Climate Readiness, Ministry of Health, and Ministry of Municipal Affairs, and First Nations*

Status: *New*

Recommendation 6:
Climate Change Resiliency and Adaptation

Create and implement collaborative and proactive opportunities to improve climate change resiliency of water supply systems and the drinking water protection program.

Lead: *Ministry of Health, in collaboration with the Ministry of Water, Land and Resource Stewardship, Comptroller of Water Rights, Ministry of Environment and Climate Change Strategy, Ministry of Municipal Affairs, and regional health authorities*

Status: *New*

Recommendation 7:
Regulatory Conflict Pertaining to the Authorization of Joint Works and Water Users' Communities

Address the regulatory conflict between the *Drinking Water Protection Act, Water Sustainability Act*, and *Water Users' Communities Act*:

a. Review the definitions of "water supply systems", "water users' communities", "waterworks purpose", and "domestic use" across all statutes, and identify options to harmonize the definitions that consider public health protection, ecosystem protection, small water system capacity, and prevention of unsustainable water supply systems.

b. Review the processes for authorizing the construction of joint works used for drinking water across the statutes, and identify options for coordinating approval processes to prevent the creation of small water supply systems without all the necessary approvals.

Lead: *Ministry of Water, Land and Resource Stewardship, in collaboration with the Ministry of Health and the Comptroller of Water Rights*

Status: *Refreshed – adapted from Recommendation 6 – No Action Taken*

RECOMMENDATION 8:
Public Assent Processes and the *Community Charter*

Review the waiver of public assent for borrowing processes related to the installation of treatment works for local government drinking water systems under the Municipal Liabilities Regulation in the *Community Charter*. Identify an alternative strategy to remove barriers to borrowing for necessary infrastructure improvements while also providing a streamlined opportunity for public assent. As part of this review, consider the liquid/solid waste management plans under the *Environmental Management Act* as models.

Lead: *Ministry of Municipal Affairs*

Status: *Refreshed – adapted from Recommendation 7 – No Action Taken*

12.2.3 Evaluation and Accountability of Program Activities – Information Management and Information Technology

To improve the oversight, evaluation, and reporting of the drinking water program in BC, it is necessary to have more data that are useful, consistent, and readily available. To address this data gap, the PHO, in consultation with the regional health authorities and HLTH, developed new indicators and standardized data categories for types and sizes of water systems and sources to inform future reporting and policy development. These changes will improve the understanding of drinking water protection programs and drinking water systems, where they succeed, and reveal where more work needs to be done. Since the release of the last PHO report, the regional health authorities have made some progress in adapting their data systems to report on the PHO indicators; however, they still have a long way to go to report easily and completely to the PHO annually. The impacts of the COVID-19 pandemic and other emergencies during this reporting period challenged the regional health authorities' ability to implement the PHO indicators and report in a timely way. During this reporting period, HLTH launched the Drinking Water Information System project. This project promises to support standardized data collection and the PHO's mandate to report on activities under the DWPA in a timely way. The Drinking Water Information System project must consider linkages to other provincial water quality data systems, as well as water sample results from water testing laboratories.

RECOMMENDATION 9:
Implementation of Drinking Water Indicators for Annual Reporting

Adapt health authority data systems to:

a. Align data fields and data collection with the indicators for drinking water and water system categories that were developed collaboratively by the Provincial Health Officer and regional health authorities, and begin reporting these data by the end of 2024.

b. Effectively track drinking water program activities under the *Drinking Water Protection Act*, including inspections, investigations, enforcement actions, reconsideration of decisions, and drinking water officer engagement and interactions with water suppliers, operators, local governments, and the public.

Lead: *Regional health authorities*

Status: *Refreshed – adapted from Recommendations 8a and 32 – In Progress*

Recommendation 10:
Provincial Information Management/ Information Technology Strategy

Complete the development of the provincial Drinking Water Information System (as part of the larger provincial Environmental Health Information System) and implement it. Ensure data fields are relevant, reliable, consistent, and accessible and build on the indicators and water system categories developed collaboratively by the Provincial Health Officer, regional health authorities, and Ministry of Health. When developing the Drinking Water Information System module:

a. Develop standardized data collection and entry guidance for the Drinking Water Information System module that is supported by standardized business and inspection processes. This guidance should include direction on what information and requirements must be met to be able to report out on the Provincial Health Officer indicators for the multi-barrier approach (i.e., source water protection, robust treatment, distribution integrity, monitoring and reporting, and operations and management).

b. Develop a process within the Drinking Water Information System to uniformly review water systems to identify those that do not meet the BC surface water or groundwater treatment objectives and to inform the assessment of risk for water systems. This assessment will inform the development of financial plans and compliance processes to meet the treatment objectives and will help identify where resources should be directed to reduce risk and achieve identified target dates for infrastructure improvements.

c. Develop and resource an action plan and strategy to make drinking water chemistry data for water supply systems that are analyzed by private laboratories available as part of a provincial data system.

d. Identify necessary data fields and plan for future interoperability with other provincial databases to support the assessment of risk of drinking water sources from a quality and quantity perspective.

Lead: *Ministry of Health, in collaboration with the regional health authorities, Ministry of Water, Land and Resource Stewardship, Ministry of Municipal Affairs (10.b), and Ministry of Environment and Climate Change Strategy (10.d)*

Status: *Refreshed – adapted from Recommendations 8b, 14, and 25 – In Progress*

Recommendation 11:
Water Quality Data Sharing

Complete the development of an enhanced data platform to share source water quality monitoring data among agencies that have responsibilities in source water protection.

Lead: *Ministry of Environment and Climate Change, in collaboration with the Ministry of Water, Land and Resource Stewardship*

Status: *Refreshed – adapted from Recommendation 26 – In Progress*

12.2.4 Small Water System Governance and Sustainability

The 2019 PHO drinking water report outlined the financial and management capacity issues that small water systems face and called for the development of a small water system strategy, including a strategy to encourage and facilitate small water system acquisition, improvement

district conversion, and improved processes for the incorporation and dissolution of water users' communities and utilities. The report also called for HLTH and the regional health authorities to develop a minimum recommended standard of training for small water systems operators. This standard would help drinking water officers determine whether a small water system has an adequately trained operator. Unfortunately, little progress was made during this reporting period toward developing a small water system strategy. The small water system recommendations from the last report have been updated and combined with Recommendation 12, which calls for the development of a provincial small water system strategy as part of a Source-to-Tap Strategy (Recommendation 1) with interagency commitment and involvement.

Recommendation 12:
Small Water System Strategy

Develop a provincial small water system strategy as part of a provincial Source-to-Tap Strategy (Recommendation 1) with interagency commitment to:

a. Prevent the creation of new unsustainable small water systems during subdivision development.

b. Promote amalgamation and acquisition of small water systems.

c. Support and encourage improvement district conversion.

d. Build the capacity and sustainability of existing small water systems.

e. Identify opportunities to strengthen the governance of improvement districts, private water utilities, water users' communities, and other small water systems, and identify processes to support the quick conversion and dissolution of such systems when their governance structure fails or falls into receivership or escheat.

Lead: *Ministry of Water, Land and Resource Stewardship, in collaboration with the Ministry of Health, Comptroller of Water Rights, Ministry of Municipal Affairs, and Ministry of Transportation and Infrastructure*

Status: *Refreshed – adapted from Recommendations 9 - In Progress and 10–12 - No Action Taken*

Recommendation 13:
Operator Training for Small Water Systems and Bulk Water Haulers

Develop a minimum recommended standard of training and competencies for small water system operators and bulk water haulers. Standards for small water systems should consider their varying sizes, levels of complexity, water sources, and governance structures.

Lead: *Ministry of Health, in collaboration with the regional health authorities*

Status: *Refreshed – adapted from Recommendation 22 – No Action Taken*

12.2.5 Provincial Drinking Water Protection Program Resources

This report highlights ongoing drinking water program resource challenges. In fact, the pressures and staffing shortages, particularly within Interior Health and Northern Health, have worsened. The impacts of the COVID-19 pandemic response and climate-related emergencies have been felt across all regional health authority drinking water programs, drinking water laboratories, and the provincial drinking water program. Therefore, it remains necessary that the province, regional health authorities, and BC Centre for Disease Control work together to address resourcing and training needs for the drinking water program and to identify a strategy for service delivery in rural and remote areas of the province.

Recommendation 14:
Access to Approved Laboratories

Develop and resource a strategic approach to:

a. Support improved access to water testing in remote and rural areas. This includes but is not limited to exploring the use of Level C laboratories and point-of-use testing for microbiological indicators, and partnering with neighbouring First Nations community-based monitors.

b. Prepare a continuity plan for a routine microbiological water quality sampling program in BC for disruptions caused by climate-related or other types of emergencies that may disrupt laboratory supply chains, staffing, transportation networks, access to communities, sample pickup locations, or access to laboratories.

Lead: *BC Centre for Disease Control Public Health Laboratory, in consultation with the Ministry of Health, regional health authorities, and First Nations Health Authority*

Status: *Refreshed – adapted from Recommendation 27 – In Progress*

Recommendation 15:
Drinking Water Program Resources and Training Requirements

a. Determine the extent of the current backlog of inspections and routine work in each region, and identify the resources required to mitigate the backlog.

b. Provide support and opportunities for the regional health authorities to catch up on the current backlog of inspections and assessments with water suppliers.

c. Review the resources and training needed by Ministry of Health, Provincial Health Officer, regional health authorities, and Ministry of Water, Land and Resource Stewardship staff to effectively fulfil their roles under the *Drinking Water Protection Act* going forward, including incorporating the impacts that climate-related emergencies will continue to have on program resource requirements, and provide sufficient resources and a framework for training to meet these mandates.

Lead: *15.a Regional health authorities; 15.b Ministry of Health; 15.c Ministry of Health, in collaboration with the Provincial Health Officer, regional health authorities, and Ministry of Water, Land and Resource Stewardship*

Status: *Refreshed – adapted from Recommendations 29 and 30 – In Progress*

12.2.6 Drinking Water Officers' Guide – Recommendations for Specific Guidance

The 2019 PHO drinking water report and this report identified additional guidance for drinking water officers that should be included in the BC *Drinking Water Officers' Guide*. Four of five of the following recommendations are carried forward from the previous report. Developing guidance for source and system assessment, distribution operation and maintenance, and asset management and financial planning will help drinking water officers asses and report on progress in source protection, distribution integrity, and water system management using the new PHO indicators.

Recommendation 16:
Source Water Risk Assessment Framework

a. Develop a provincial framework for assessing risks to drinking water sources that is based on accurate data on source waters, drinking water system and intake locations, and known hazards.

b. Contingent upon the completion of the provincial framework (16.a), review existing source and system assessment tools and guidance for water suppliers (e.g., *Comprehensive Drinking Water Source-to-Tap Assessment Guideline, Drinking Water Source-to-Tap Screening Tool, Water System Assessment User's Guide*) to identify areas for modernization and improvement, and develop guidance for drinking water officers on which type of water source and system assessment is required for different types and sizes of water suppliers.

Lead: *16.a Ministry of Water, Land and Resource Stewardship, in collaboration with the Ministry of Health; 16.b Ministry of Health, in collaboration with the Ministry of Water, Land and Resource Stewardship and regional health authorities*

Status: *New*

Recommendation 17:
Distribution System Integrity and Maintenance

Develop provincial guidance for drinking water officers regarding the assessment of distribution system integrity, management, cross-connection control, corrosion, and maintenance that considers the varying sizes, capacities, and complexities of water systems. Using this guidance as a basis, develop common inspection processes and data collection requirements for the assessment of distribution system integrity and maintenance.

Lead: *Ministry of Health, in collaboration with the regional health authorities*

Status: *Refreshed – adapted from Recommendation 16 – In Progress*

Recommendation 18:
Asset Management and Financial Planning

a. Develop guidance for drinking water officers on the essential elements of asset management plans and financial plans for different types of water systems that can be referenced during an inspection or assessment of the management of a water system.

b. Using this guidance as a basis, develop common inspection processes and data collection requirements with the regional health authorities for the assessment of this indicator of water system management.

Leads: *18.a Ministry of Municipal Affairs, in collaboration with the Ministry of Health; 18.b Ministry of Health, in collaboration with the regional health authorities*

Status: *Refreshed – adapted from Recommendation 24 – In Progress*

Recommendation 19:
Bulk Water Haulers

Develop provincial guidance for bulk water haulers to reflect current regulatory requirements and best practices.

Lead: *Ministry of Health, in collaboration with the regional health authorities*

Status: *Refreshed – adapted from Recommendation 20 – No Action Taken*

Recommendation 20:
Investigating Threats to Drinking Water

Develop further guidance on investigating threats to drinking water under section 29 of the *Drinking Water Protection Act*. This guidance should clarify the scope of section 29 investigations where assessments are required outside of the capacity of the health authority (e.g., hydrogeological assessments).

Lead: *Ministry of Health, in collaboration with the Ministry of Water, Land and Resource Stewardship and regional health authorities*

Status: *Refreshed – adapted from Recommendation 31 – In Progress*

12.3 Conclusion

This report outlines the drinking water protection activities that were conducted in BC from 2017/18 to 2021/22. It also provides an overview of the impacts of the COVID-19 pandemic and climate-related events on drinking water and the Province's health protection programs. Lastly, this report provides an update to the 32 recommendations in the 2019 PHO drinking water report and presents five new recommendations and 15 refreshed ones that were carried forward from the last report and were adapted.

The provision of clean, safe, and reliable drinking water remains a priority in BC, as reflected in the mandate of WLRS (formed in 2022) to lead the coordination of a new Source-to-Tap Strategy for the province. This strategy must support the multi-barrier approach, include a small water system strategy, incorporate the principles of the 2002 Action Plan[5] (see text box), and create principles that reflect new realities such as climate preparedness and co-governance with Indigenous Peoples.

Principles for Drinking Water Protection Outlined in the 2002 Action Plan[5]

1. The safety of drinking water is a public health issue.
2. Source protection is a critical part of drinking water protection.
3. Providing safe drinking water requires an integrated approach.
4. All water systems need to be thoroughly assessed to determine risks.
5. Proper treatment and water distribution system integrity are important to protect human health.
6. Tap water must meet acceptable safety standards and be monitored.
7. Small systems require a flexible system with safeguards.
8. Safe drinking water should be affordable, with users paying appropriate costs.

REFERENCES

[1] BC Ministry of Water, Land and Resource Stewardship. Watershed strategy co-developed with First Nations, $100 million invested. [Internet]. Victoria, BC: BC Ministry of Water, Land and Resource Stewardship; 2023 May 06. Available from: *https://news.gov.bc.ca/releases/2023WLRS0008-000267*.

[2] Kot M. Personal communication. BC Ministry of Health, Health Protection Branch; 2022 Dec 5.

[3] CGI Inc. Phase 1 – Drinking Water Information System (DWIS) project. Report of findings and prioritized requirements. CGI Inc.; 2022 May 26.

[4] BC Ministry of Health. Strengthening Public Health Initiative; [unpublished]. Victoria, BC. BC Ministry of Health; 2023 May 3.

[5] BC Ministry of Health Planning, BC Ministry of Health Services. Action plan for safe drinking water in British Columbia. [Internet]. Victoria, BC: BC Ministry of Health Planning, BC Ministry of Health Services; 2002 [cited 2023 Feb 10]. Available from: *https://www2.gov.bc.ca/assets/gov/environment/air-land-water/safe_drinking_printcopy.pdf*.

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www.health.gov.bc.ca/pho/reports/drinkingwater