CIVIL AND TRANSPORTATION INFRASTRUCTURE

PREPARATION OF ONE WATER SYSTEM RISK MANAGEMENT PLANS IN BRITISH COLUMBIA

VERSION 1.0
PUBLISHED APRIL 26, 2024

ENGINEERS & GEOSCIENTISTS
BRITISH COLUMBIA

FUNDING PROVIDED BY:

BRITISH COLUMBIA | Ministry of Health

FIRST PUBLISHED: VERSION 1.0, APRIL 26, 2024

PREFACE

These *Interim Professional Practice Guidelines—Preparation of One Water System Risk Management Plans in British Columbia* were developed by Engineers and Geoscientists British Columbia (referenced throughout these guidelines as Engineers and Geoscientists BC) to guide professional practice related to managing a community's enterprise-level water system risks. These interim professional practice guidelines provide considerations for using a One Water approach, which encompasses the entire water system, from source to tap and sink to watershed. These guidelines have been developed to establish the duties and obligations expected of Engineering/Geoscience Professionals when engaged to apply a One Water lens to water system risk management in British Columbia (BC).

These interim professional practice guidelines were first published in 2024 to establish, monitor, and enforce standards for the professional practice of Engineering/Geoscience Professionals in BC. The approach outlined herein represents a new approach to risk management for water sector professionals in BC, therefore, these have been issued as interim professional practice guidelines. Offering these as interim will enable policy, funding, and human resource capacity to be established and allow tools, resources, and training to be developed, which will enable wider implementation across BC. After a two-year period, feedback will be sought from users, so that Engineers and Geoscientists BC may revise these professional practice guidelines before finalizing them.

These guidelines are intended for use in various jurisdictional settings, including urban cities, Indigenous communities, regional districts, and rural communities. Where the terms "community" or "government" are used, they are applied to be inclusive of Indigenous communities and governments, while respecting and acknowledging the specific Rights, interests, priorities, and concerns of First Nations, Métis, and Inuit Peoples as distinct Peoples with unique cultures, histories, Rights, laws, and governments.

The development of One Water System Risk Management Plans (WSRMPs) is water-based work. Engineers and Geoscientists BC gratefully acknowledges First Nations, who have been the caretakers and knowledge keepers of these waters since time immemorial. First Nations hold knowledge of and relationships with the water that contributes to and enhances WSRMPs. As Rights and title holders, it is important to recognize each Nations' diverse sources of knowledge, experiences, and relationships with the water and their territories.

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ABBREVIATIONS

ABBREVIATION	TERM
BC	British Columbia
WSRMP	One Water System Risk Management Plan

DEFINED TERMS

The following definitions are specific to these guidelines. These words and terms are capitalized throughout.

TERM	DEFINITION
Bylaws	The Bylaws of Engineers and Geoscientists BC made under the *Professional Governance Act*.
Client	An individual or company that engages a Qualified Professional to conduct a One Water System Risk Management Plan. The Client is typically the Owner of the public utility, or a third party who has been contracted to maintain the utility on behalf of the Owner.
Direct Supervision	The responsibility for the engineering or geoscience work of a subordinate. Refer to the *Quality Management Guide—Guide to the Standard for Direct Supervision* (Engineers and Geoscientists BC 2023a) for more information.
Drinking Water Officer	A person who has been appointed or delegated the authority to enforce the *Drinking Water Protection Act*.
Engineering/Geoscience Professional(s)	Professional engineers, professional geoscientists, professional licensees engineering, professional licensees geoscience, and any other individuals registered or licensed by Engineers and Geoscientists BC as a "professional registrant" as defined in Part 1 of the Bylaws.
Engineers and Geoscientists BC	The Association of Professional Engineers and Geoscientists of the Province of British Columbia, also operating as Engineers and Geoscientists BC.
Enterprise Risk Management	The coordinated, ongoing application of risk management across all parts of an organization, at all levels, from strategic planning to service delivery.
Local Community Governing Bodies	A local authority (e.g., municipality, regional district), First Nation (including those who are self-governing, Treaty and non-Treaty Nations, and those who operate under the *Indian Act* or land codes), or other public administration tasked with making decisions on legislative framework and providing services to their community.
One Water	As defined by the Water Research Foundation, One Water is an integrated planning and implementation approach to managing finite water resources for long-term resilience and reliability, meeting both community and ecosystem needs. Note: Where these guidelines refer to "water systems", they refer to the combination of watershed, drinking water, wastewater, storm water, and water reuse systems.
One Water System Risk Management Plan	An integrated, scalable plan, that is developed by a Qualified Professional for the management of enterprise risks to watershed, drinking water, wastewater, storm water, and water reuse systems that have the potential to impact public and environmental health. A One Water System Risk Management Plan is an Enterprise Risk Management tool to safely and responsibly manage water system risks.
Owner	The entity that owns the drinking water supply systems and/or municipal wastewater systems.
Public Health Official	An environmental health officer or medical health officer, as defined by the *Public Health Act*. A public health engineer, environmental health officer, or a health official, as defined by the First Nations Health Authority.

TERM	DEFINITION
Qualified Professional	An Engineering/Geoscience Professional who has the required education, training, and experience (as outlined in Section 5.0 of these guidelines) to carry out a systems-level risk assessment with the level of analysis as described in these guidelines and to take professional responsibility for the preparation of the One Water System Risk Management Plan.
Registrant	A Registrant of Engineers and Geoscientists BC, as defined in Schedule 1, section 5 of the *Professional Governance Act*.
Risk Register	A summary of the risks identified during the development of the One Water System Risk Management Plan.

VERSION HISTORY

VERSION NUMBER	PUBLISHED DATE	DESCRIPTION OF CHANGES
1.0	April 26, 2024	Interim professional practice guidelines

ACKNOWLEDGEMENTS

These guidelines were authored by WSP Canada Inc. with review and input from Engineers and Geoscientists BC and the Ministry of Health. Authorship and review of these guidelines does not necessarily indicate the individuals and/or their employers endorse everything herein.

We wish to acknowledge the funding received from the Ministry of Health and the Pacific Institute for Climate Solutions, and the support for engagement workshops provided by the BC Water & Waste Association.

The following organizations supported the development of these guidelines through their participation in the steering committee and engagement workshops, and by reviewing these guidelines.

- BC Water & Waste Association
- City of Fort St. John
- City of North Vancouver
- City of Vancouver
- First Nations Health Authority
- Indigenous Services Canada
- Interior Health
- Ministry of Emergency Management and Climate Readiness
- Ministry of Environment and Climate Change Strategy
- Ministry of Health
- Ministry of Municipal Affairs
- Ministry of Water, Land and Resource Stewardship
- Partnership for Water Sustainability
- Regional District of Nanaimo
- Vancouver Coastal Health

The following firms supported the development of these guidelines:

- James Laurence Group facilitated engagement with pilot communities and potential users of these guidelines, and subsequently held consultations in order to develop a What We Heard Report.
- Kerr Wood Leidal conducted a gap analysis of existing risk management tools in relation to potable water systems and developed the complementary One Water System Risk Management Planning Guide.
- Wildgrass Consulting Inc. conducted a critical review of the 2018 draft of these professional practice guidelines.
- WSP carried out pilot water system risk management plans with Fort St. John and the City of Vancouver, conducted a critical review of the 2018 draft of these professional practice guidelines, and provided a review of version 1.0 of these professional practice guidelines.

1.0 INTRODUCTION

1.1 BACKGROUND TO THE ONE WATER APPROACH

The historical approach to the regulation of water and wastewater management is a compliance model focused on technical risks within the drinking water supply and wastewater treatment system. However, this compliance model does not take enterprise-level system risks into account, which, if not addressed, can lead to environmental and public health risks. To address these common risks found in British Columbia (BC)'s water management, a One Water approach is proposed within these guidelines, should communities choose to undertake this work. This approach builds on past work done by government, industry, and research organizations and has been developed by using input from a wide range of subject matter experts and interested parties.

A systems approach looks beyond just the technical risks involved and considers a more holistic view of enterprise-level system risks—such as those from human resourcing, finances, and disaster vulnerability—that could impact the ability to protect public and environmental health if not addressed. A One Water approach considers the watershed, drinking water, wastewater, stormwater, and water reuse systems as an overall single resource.

These guidelines apply Enterprise Risk Management as an effective way for organizations to identify and manage risks that may require cross-departmental collaboration and senior level decision making. The One Water approach considers system-level enterprise risk across the entire water system, from source to tap and sink to watershed.

Aside from its life-sustaining role, water carries multiple values and benefits. This includes its role in our social and cultural sphere supporting mental health, recreation, and spiritual well-being, its role in our natural environment sustaining biodiversity and ecosystems, and its economic role sustaining industry, agriculture, tourism, and energy supply, among others. The One Water approach can help to reconcile these values through an integrated and holistic approach to governance, operations, and financing mechanisms, by responding to the fundamental need for the inclusive and effective participation of all users in decision-making, allowing for a collaborative risk-informed approach to water management.

Figure 1: Our Water Systems

1.2 BACKGROUND TO THE ONE WATER SYSTEM RISK MANAGEMENT PLAN

BC's water systems are critical pieces of our ecosystems and community infrastructure, which contribute to a high quality of public and environmental health. However, these water systems face many challenges, including:

- limited public understanding of water infrastructure and the value of water infrastructure to the user community;
- a significant infrastructure deficit;
- changing regulatory requirements; and
- a shortage of skilled workers.

Additionally, the impacts of climate change are altering the frequency and severity of climate hazards such as floods, wildfire, and droughts. These have created human resource, financial, infrastructure, and asset management challenges within our water systems.

Through a recognition that these risks cannot be managed in isolation, the One Water System Risk Management Plan (WSRMP) concept was developed by professionals across communities in BC, water industry associations, and provincial Ministries, to determine how to address these challenges related to water systems. The concept suggested that a One Water system risk management approach could:

- integrate the many facets of managing community drinking water, wastewater, stormwater, water reuse, and watersheds;
- improve collaboration within and between water utilities;
- identify solutions for the lack of skilled water and wastewater industry workers; and
- achieve improved resiliency of drinking water and wastewater systems.

A steering committee established in 2015 guided the initial work, establishing the vision and scope of the guidelines for developing WSRMPs. Draft guidelines were completed in 2018, which were then used to launch pilot projects that tested the guidelines. Following the completion of the pilot projects, there was an engagement process that sought to understand and gather feedback on what worked well and what did not work well. This feedback was summarized in a *What We Heard Report* and a critical review was conducted to synthesize results and provide recommendations for revising the draft guidelines and implementing the One Water approach. Further engagement took place on the revised objectives and a working group was established to review these guidelines prior to their release.

1.3 VALUE OF A ONE WATER APPROACH

A One Water approach is an integrated planning and implementation approach to managing finite water resources for long-term resilience and reliability, meeting both community and ecosystem needs. This allows for the identification of risks and opportunities at the system level and is based on these fundamental concepts:

- All water systems are interconnected and sustain life and culture.
- A collaborative approach will enable decision-making and partnerships through transparent engagement with communities, governments, regulators, and the public.
- A risk management approach allows us to assess and prioritize multiple competing risks.
- Opportunities to leverage interconnections that address the long-term resiliency of water resources exist at a system level.

The One Water concept considers water as a finite, single resource that needs to be shared sustainably between different water needs, without threatening its quantity or quality and by supporting basic principles of equity, sustainability, and human rights, as articulated in the United Nations Sustainable Development Goals. Using a One Water approach also addresses the overarching impacts of climate change on our water systems by understanding the interconnections between risks and by developing approaches to support long-term climate resilience.

Since time immemorial, Indigenous peoples have been stewards of the environment that sustains life, honouring the interconnectedness of all things, and taking the responsibility to care for water now and for future generations. The collaborative One Water approach can enable opportunities for Indigenous communities and non-Indigenous communities to partner, engage, or collaborate with each other, and can also enable opportunities to integrate Indigenous ecological knowledge, apply values of Indigenous water stewardship, and advance reconciliation. This is in alignment with the implementation of the *Declaration on the Rights of Indigenous Peoples Act*, which establishes the United Nations Declaration on the Rights of Indigenous Peoples as BC's framework for reconciliation, as called for by the Truth and Reconciliation Commission's Calls to Action.

1.4 APPLICABILITY

These guidelines provide guidance on professional practice for Engineering/Geoscience Professionals who carry out the development of WSRMPs.

While these guidelines are written for Engineers and Geoscientists BC Registrants, they can also inform others working in the water sector, including water utility staff and operators, community staff, and public health authorities and officials. A public-facing *One Water System Risk Management Planning Guide* has been developed and is a stand-alone resource that is complementary to these guidelines.

Engineering/Geoscience Professionals must exercise professional judgment when providing professional services; as such, the application of these guidelines will vary depending on the circumstances. An Engineering/Geoscience Professional's decision not to follow one or more aspects of these guidelines does not necessarily represent a failure to meet professional obligations. For information on how to appropriately depart from the practice guidance within these guidelines, refer to the *Quality Management Guide—Guide to the Standard for the Use of Professional Practice Guidelines* (Engineers and Geoscientists BC 2023b), Section 3.4.2.

1.5 OBJECTIVES

The overarching objectives of the WSRMP process are to protect public health and the environment. A community may choose to undertake this process to:

- develop a holistic understanding of the risks facing their water system;
- prioritize these risks by identifying the recommended actions and opportunities to deliver consistent levels of service and by focusing finances where they are most needed;
- strategically communicate the identified risks and opportunities to decision makers, the public, and other water users;
- strengthen relationships with regulators, ministries, and/or a diverse range of partners; and
- enhance the resilience of the infrastructure and ecosystems in BC.

In the absence of direct legislation that requires the development of WSRMPs, these plans can be developed proactively in recognition of the need for an integrated approach to address water quality or quantity issues, aging and/or inadequate infrastructure, climate resiliency, and to protect ecosystems from degradation.

The development of these plans can also be initiated or catalyzed through regulatory (e.g., as required by a Drinking Water Officer and/or Public Health Official) or financial mechanisms (e.g., for leveraging infrastructure planning grant funding or other similar funding opportunities) or in support of implementing regional or community plans.

2.0 OVERVIEW

2.1 PURPOSE

A One Water System Risk Management Plan (WSRMP) is an Enterprise Risk Management tool for managing water system risks in a safe and responsible manner. These guidelines support an integrated, scalable One Water approach that aims to identify, assess, and mitigate risks to public health and the environment. The One Water approach does this by recognizing the interconnectedness of source water, drinking water, wastewater, stormwater, and watersheds. These guidelines:

- provide a framework to create WSRMPs for managing water system risks in a safe and responsible manner;
- provide Engineering/Geoscience Professionals with a consistent approach to water system risk management planning; and
- address a wide range of risks to water systems, including climate change, aging infrastructure, finances, and a shortage of human resources.

2.2 SCOPE

The scope of a WSRMP is an enterprise risk assessment of a community's entire One Water system, which will aid in prioritizing system level risks. The enterprise risk assessment is intended to be based on existing information, rely on professional judgement, and should integrate, not duplicate, the plans a community already has in place. The guidance provided in these guidelines is flexible, non-prescriptive, and scalable. Water systems Owners can plan the risk management process so that it meets their organizational needs and the most relevant risks. Defining the One Water system, deciding on the approach, and identifying key relationships, are all important steps in scoping the WSRMP, as detailed below.

2.2.1 DEFINING THE ONE WATER SYSTEM

The One Water system considers all components, from the source to tap and sink to watershed. This may include the watershed, drinking water system, wastewater system, water reuse system, and stormwater system, depending on the community. Defining the One Water system and identifying its critical infrastructure components is an important step in scoping the WSRMP, as this will inform the level of detail and effort required within.

Table 1: Defining the One Water System

EXAMPLE	ONE WATER SYSTEM COMPONENTS	CRITICAL INFRASTRUCTURE COMPONENTS	LEVEL OF DETAIL AND EFFORT REQUIRED IN THE WSRMP
A community managing and operating a watershed, and drinking water, wastewater, and stormwater systems.	• Watershed • Drinking water system • Wastewater system • Stormwater system • Receiving environment	• Water source • Raw water intake • Groundwater well • Water treatment plant • Distribution system • Pump stations • Wastewater treatment plant • Wastewater discharge • Collection system • Stormwater system	Lower
A regional district, First Nation, or Tribal Council with multiple distinct watersheds, drinking water systems, wastewater systems, and stormwater systems. The regional district or First Nation has jurisdiction over some components of the One Water System.	System 1 • Watershed • Drinking water system 1 System 2 • Watershed • Drinking water system 2 • Wastewater system for systems 1 and 2 • Receiving environment	System 1 • Raw water intake • Water treatment plant • Pump station • Distribution system System 2 • Raw water intake • Water treatment plant • Pump station • Distribution system • Wastewater collection system • Wastewater treatment plant • Outfall	Higher

2.2.2 APPROACHES TO SCOPING THE WSRMP

There are various approaches to scoping the WSRMP, depending on the community's objectives and the level of complexity of their One Water system. These approaches are illustrated with increasing levels of complexity in Table 2.

Table 2: Approaches to Scoping a One Water System Risk Management Plan

COMPLEXITY OF ONE WATER SYSTEM	EXAMPLE	APPROACH
One integrated system	A First Nation or local government managing and operating a watershed, and drinking water, wastewater and stormwater systems.	The Owner wants a holistic understanding and prioritization of risks across their One Water system. The Qualified Professional should use the eight risk categories to assess and prioritize risks across the system.
Portfolio of one type of asset	A First Nation or regional district is only responsible for drinking water. Other entities are responsible for the remaining water systems.	The Owner may want to assess the risks of only the drinking water systems, but also wants to collaborate with the other entities, to understand the risks at a systems level. The Qualified Professional should use the eight risk categories to assess and prioritize risks across the drinking water systems. The Qualified Professional should facilitate knowledge exchange with the other entities to understand the connections between components of the One Water system.
Portfolio of many assets	A First Nation, Tribal Council, or regional district with multiple distinct watersheds, drinking water systems, wastewater systems and stormwater systems, which may cross multiple First Nation reserves and/or municipal boundaries.	The Owner may want a holistic prioritization of risks across their multiple One Water systems. The Qualified Professional should first understand the connections between the components of the water systems, and then use the eight risk categories to assess the risks across the systems. The Qualified Professional should use their judgement in how to best organize the information and reporting.

2.2.3 IDENTIFYING KEY RELATIONSHIPS

Communities typically have multiple relationships in place that help to manage the One Water system. This can include relationships with regulators, neighbouring communities, Rights Holders, and emergency management centres, among others. These relationships could also include ones with those who are large water users or who have considerable impacts to the watershed, such as industries and those who manage agricultural lands in the community. Identifying the key relationships already in place is an important component of scoping the WSRMP.

Table 3: Approaches to Identifying Key Relationships

EXAMPLE	ONE WATER SYSTEM COMPONENTS	KEY RELATIONSHIPS
A local government or First Nation managing and operating a watershed, and drinking water, wastewater, and stormwater systems.	• Watershed • Drinking water system • Wastewater system • Stormwater system • Receiving environment	Key relationships may be with neighbouring communities for emergency management or cross training, with local regulators to ensure that key risks are well understood, and with the water system users.
A local government who operates a drinking water system and stormwater system, and relies on the regional district for wastewater treatment.	• Watershed • Drinking water system • Stormwater system • Wastewater collection system • Receiving environment	A key relationship will be with the regional district who owns and operates the regional wastewater treatment system.
A small community managing and operating a watershed, drinking water system, and wastewater system with discharge to ground.	• Watershed • Drinking water system • Wastewater system • Receiving environment	Key relationships may be with the health authority, with neighbouring communities for emergency management or cross training relationships, and with other users of the watershed.

2.3 ROLES AND RESPONSIBILITIES

2.3.1 PROJECT TEAM

The development of the WSRMP is led by the Owner, as they initiate the process and work with a Qualified Professional to complete the work.

The composition of the project team, as determined by the representative(s) of the water system, will vary depending on the size of community and the needs of the assessment.

Engagement with subject matter experts, partners, and interest-holders is an important part of the process and should include the spectrum of people who work within the water system. Incorporating Indigenous Knowledge and cultural connection to the lands with western knowledge can help to understand historical risk, and influence stewardship.

The assessment of each risk category may require a different mix of skills, knowledge, and expertise. This mix could involve a cross-section of the following people:

- Engineering/Geoscience Professionals
- Technologists, scientists, biologists
- Planners, asset management specialists
- System operators
- Financial management personnel
- Human resource personnel
- Emergency management personnel
- Chiefs and/or Councils

- Chief administrative officers
- Municipal, regional, First Nation, or federal government representatives, as applicable
- Representatives from regulatory agencies
- Public health officials
- Representatives from neighbouring communities

2.3.2 QUALIFIED PROFESSIONAL

Within these guidelines, the Qualified Professional is an Engineering/Geoscience Professional who has the required education, training, and experience to develop WSRMPs, as detailed in Section 5.2. Qualified Professionals work with Owners to assess the risks to their One Water systems. The role of the Qualified Professional is to meet the intent of these guidelines when engaged to develop a WSRMP.

Part of the role of the Qualified Professional is the preparation of a report, which details any and all risks found during the development of the WSRMP. It is the responsibility of the Qualified Professional, as required, to assemble a multi-disciplinary team of individuals with the appropriate qualifications and experience in relevant disciplines to carry out the One Water risk assessment. The multidisciplinary team will serve to inform the Qualified Professional's identification and assessment of risks and information gaps, and the preparation of the report. The Qualified Professional is not expected to take professional responsibility for any risks found themselves, nor the management of these risks.

Having regard for professional practice guidelines means that Engineering/Geoscience Professionals must follow established and documented procedures to stay informed of, be knowledgeable about, and meet the intent of any professional practice guidelines related to their area of practice. By carefully considering the objectives and intent of the professional practice guidelines, an Engineering/Geoscience Professional can then use their professional judgment when applying the guidance to a specific situation.

2.3.3 ENGINEERS AND GEOSCIENTISTS BC

Engineers and Geoscientists BC is the regulatory and licensing body for the engineering and geoscience professions in BC. To protect the public, Engineers and Geoscientists BC establishes, monitors, and enforces standards for the qualification and practice of its Registrants.

Engineers and Geoscientists BC provides various practice resources to its Registrants to assist them in meeting their professional and ethical obligations under the *Professional Governance Act* and the Bylaws. Those practice resources include professional practice guidelines, which are produced under the authority of Section 7.3.1 of the Bylaws and are aligned with the Code of Ethics Principle 4.

Each of the professional practice guidelines describe the expectations of professional practice that all Engineering/Geoscience Professionals are expected to have regard for in relation to specific professional activities. Engineers and Geoscientists BC publishes professional practice guidelines on specific professional activities where additional guidance is deemed necessary. Professional practice guidelines are written by subject matter experts and reviewed by collaborators and contributors before publication.

3.0 ONE WATER SYSTEM RISK MANAGEMENT PLAN PROCESS

3.1 PROCESS OVERVIEW

A One Water System Risk Management Plan (WSRMP) is an enterprise-level document for managing system level risks in the water system and documenting the outcomes of that process.

Eight risk categories—as illustrated in Figure 2—have been designed to identify, assess, and understand risks at the systems level. These risk categories are described in the following sections.

The risk categories include sources of risk that are typically relevant to water systems and tools that are typically used to manage these risks. The Qualified Professional should use these risk categories to help identify relevant sources of risk to the One Water system. This enables understanding of the system as a whole, allows for collaboration across the water system, and provides a framework to implement a One Water approach.

The Qualified Professional should follow the typical WSRMP process, as shown in Figure 3. This is consistent with the *ISO 31000:2018 Risk Management Guidelines* (ISO 2018).

Figure 2: Categories of risk that impact water systems

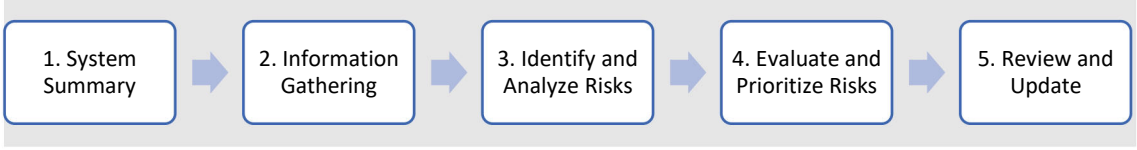

Figure 3: Typical One Water System Risk Management Plan process

3.2 PREPARATION OF A ONE WATER SYSTEM RISK MANAGEMENT PLAN

The WSRMP should be a brief, concise, top-level review of other reports, informed by existing information and professional judgement. If there is information that is not readily available from other plans or reports, then the WSRMP should not seek to produce the information, but instead should consider and identify the risks to the system due to this lack of information. The WSRMP should be prepared according to the following general outline and should include the following minimum content:

System summary

- Identify the relevant water systems that will be assessed under this WSRMP. Depending on the goals set out by the Owner, there is the potential for the Owners themselves to define the boundary of their One Water system and identify the water systems that will be assessed.
- Identify the Owner and the operator of the water system(s) and provide a concise summary of the system(s), geographic area, governance, operating licenses, and the agencies or entities that directly influence or affect the system(s).
- Identify the critical infrastructure components of the water system(s). This information can be high level or detailed, depending on the goals of the assessment.
- Identify key relationships that are important to the management of the One Water system.
- Note: where the WSRMP covers multiple water systems, it should be organized in the most logical format by the Qualified Professional.

Information gathering and review of background information

- Identify any plans, processes, or risk management strategies already completed or in use by the community.
- Utilize resources such as water, wastewater, and stormwater system schematics, flood mapping, a current organizational chart, a list of relevant plans and tools, maps of the area, and community specific figures. These resources are recommended for use through the WSRMP development process.

Risk identification and analysis

- Identify risks to the One Water system, by using the eight risk categories detailed in the following sections as guidance.
- Conduct risk identification through site visits, workshops, discussions with key personnel on the project team, and review of existing documentation and plans.
- Summarize any identified risks in a Risk Register. The Risk Register should include, at a minimum, a brief description of the risk and a prioritization. Guidance for risk analysis is provided in Appendix A: Risk Analysis of these guidelines.
- Consider the sources of each risk with respect to their impact on public and environmental health and identify whether these sources are relevant to the One Water system.
- Consider whether the risks have been adequately addressed through a risk management tool, the completion of a plan, an assessment, or by other means.
- Consider the interconnectivity between risks and determine whether some risks might exacerbate or compound others within the One Water system, significantly increasing its total impact.

- Consider the interconnectivity of risks across water systems and identify the common risks between water systems and any opportunities for risk mitigation, for example, the integration of emergency response, training, or watershed management between the utilities within the watershed.
- Note: the Qualified Professional's report detailing any risks found during the development of the WSRMP should provide a summary of each risk category with identification of any risks found within each specific category, a description of specific elements of the system(s) at risk, and the methodology used for identifying and assessing the risks that were added to the Risk Register.

Risk evaluation and prioritization

- Determine the Owner's degree of risk tolerance or willingness to accept each specific risk.
- Decide on consequent action to treat each risk.
- Note: the planning and implementation of specific risk treatment actions is not meant to be accomplished through the WSRMP development process. The treatment of risk is the responsibility of the Owner and is expected to be managed within the specific risk management plans the Owner already has or will develop.

Reviewing and updating the WSRMP

- Determine how frequently the WSRMP should be reviewed and updated depending on the risks identified. This should be decided upon by the project team. As a guideline, if risks identified in the Risk Register are mostly 'high', consider reviewing and updating annually. If risks identified are mostly 'low', consider reviewing and updating every five years at a minimum, or when significant changes take place to the One Water system.

Statement of completion by the Qualified Professional

- The WSRMP report must include the signature and seal of the responsible Qualified Professional, which confirms that the WSRMP was prepared in their professional capacity and follows these guidelines.

The following sections describe the eight risk categories and the sources of risk to consider in the One Water system when developing the WSRMP.

3.3 CATEGORY ONE—ORGANIZATIONAL RISK

Water systems are subject to policies and decisions made by people within an organizational structure. Several decision makers and employees are involved in the day-to-day management and operations of water and wastewater systems, including elected officials, Chiefs and Councils, administrative staff, system supervisors, technical staff, and operators.

The following sources of risk can be considered when assessing the organizational risk to water systems:

- Organizational structure can have an impact on the delegation of authority, accountability, and decision making. The project team should assess whether the organizational structure enables managers, operators, procurement groups, and technical staff to have access to effective lines of communication, and the resources and/or tools required for their jobs.
- Staff and knowledge management is important for maintaining trained, knowledgeable, and qualified staff, as well as retaining institutional knowledge. The project team should consider how organizational knowledge is documented and what the level of completeness is of this information.

This includes electronic data (GIS, network models), operation and maintenance manuals, record drawings, professional reports (geotechnical, environmental, engineering, planning studies etc.), condition assessments, and system knowledge from senior staff.

- Decision making takes place within an organizational structure and is subject to several factors. The project team should describe the decision-making processes that are present, such as the delegations of authority or authorization, response plans, asset prioritization systems, budget planning or authorization, and the procurement of services.
- Organizational resources must be adequate to consistently deliver quality and timely service. Contract service providers can be essential to maintaining water and wastewater systems.

Common tools to manage organizational risk may include but are not limited to:

- Decision making processes
- Documentation, such as standard operating procedures, maintenance management plans, maintenance manuals, commissioning manuals for equipment, record drawings, and emergency response plans
- Communication between departments
- Staff succession planning

Discussion points to help assess organizational risk:

- Describe the processes in place to evaluate and manage the organizational risks to the One Water system.
- Describe how management and operations staff view each other's role in delivery of service.
- Describe the process in place for making key decisions.
- Who is responsible or accountable for key decisions?
- Describe the succession plan in place for key positions and responsibilities.
- Describe the processes in place to retain and record institutional system knowledge.
- Describe the technical assistance and system knowledge available to operators and staff.
- Describe the operator certification levels compared with facility classification levels. Are they aligned?
- Are operators, technicians, technologists, and engineers in good standing with their certification/licensing bodies?
- Describe the opportunities to collaborate with other water systems, that could enhance training opportunities.

3.4 CATEGORY TWO—FINANCIAL RISK

Water systems are a significant, continuing capital investment that require constant funding to function optimally. Funding must encompass not just operations, maintenance, and monitoring, but also infrastructure renewals and emergency expenditures.

The following sources of risk can be considered when assessing the financial risk to water systems:

- The total system cost should be well understood and fully accounted for. When considering this total system cost, major upgrades and expansions, training, contract services, contingency funds for emergencies, and renewal of ageing infrastructure should all be accounted for.
- Funding and revenue sources must be balanced with a community's financial commitments. When looking at system cost recovery, consider:
  - potential liabilities;
  - debt servicing;
  - user fees (where applicable);
  - rate structures;
  - rate setting;
  - borrowing requirements;
  - parcel taxes;
  - rate bylaws;
  - fines and surcharges
  - development cost charges; and
  - alternative funding through public-private partnerships and grant application requirements.

Common programs and tools to manage financial risk may include but are not limited to:

- Financial plans
- First Nations infrastructure investment plans
- Asset management plans
- Extended Asset Condition Reporting System Program(E-ACRS)
- Maintenance Management Plan for Drinking Water and Wastewater Systems in First Nations Communities (Aboriginal Affairs and Northern Development Canada 2014)
- Own-source revenue (OSR)
- Financial Administration Law (FAL)
- Natural asset management inventory
- Cost recovery strategy
- Grant application strategy
- Rate structure
- User fees and surcharges or municipal-type service agreements
- Contingency funds
- Development cost charges bylaws
- Financial reporting
- Finance and accounting structures
- Procurement policies (local or otherwise)
- Authorization of expenditures

Discussion points to help assess financial risk:

- Describe the processes in place for evaluating and managing financial risks to the water system.
- Does the organization have the financial capacity to maintain the existing infrastructure and levels of service?
- Are the current operating costs and cost recovery creating a structural deficit?
- Describe any major capital expansions, upgrades, renewals, or replacements that are currently part of the organization's long-term financial plans.
- Describe the age and condition of major system assets.
- Do user fees and parcel taxes cover upgrades and future renewal costs?
- Describe the contingency fund that is in place for unexpected costs or emergencies.
- How do the organization's financial plans account for the potential costs associated with emergency response provisions of drinking water or wastewater?
- Is the organization able to withstand sudden or unexpected changes in revenue or costs associated with water and wastewater services?
- How do the organization's financial plans integrate human resources, adequate staffing levels, and training programs for staff?
- How do the organization's financial plans integrate the financial benefits of watershed protection activities?

3.5 CATEGORY THREE—REGULATORY RISK

Water systems are subject to regulations, protocols, standard regulatory reviews, authorizations, and approvals. Drinking water regulations are driven by risks to public health and wastewater regulations are driven by risks to public health and the receiving environment.

Where applicable, the following sources of risk can be considered when assessing the regulatory risk to water systems:

- Compliance with regulatory or protocol requirements for the protection of public and environmental health.
- Consideration of how non-compliance events are managed in the organization and communicated to regulators, the public, and the media.
- The effect of upcoming regulatory changes that may lead to the system being out of compliance.
- Consideration of how system monitoring and record keeping are implemented to optimize facility performance and identify causes of non-compliance.
- Consideration of whether non-compliance may be related to system design, age, or capacity.

Common tools to manage regulatory risk may include but are not limited to:

- Communication with regulators or public health officials
- Operator certification
- Sampling, record keeping, and reporting
- Safety certifications
- Corrective action plans
- emergency response plans
- Regulatory surveillance
- Operating permits, authorizations, licenses, and/or agreements

Discussion points to help assess regulatory risk:

- Describe the processes in place for evaluating and managing regulatory risk to the water system.
- Describe the health of the relationships with regulators and/or the local health authority. Is there a mutual understanding of the risks that need to be managed?
- Is there a history of health or environmental standards not being met?
- Describe the history of boil water orders or authorization exceedances.
- Are there any outstanding recommendations from the local health authority?
- What are the protocols if a boil water order or authorization exceedance takes place?
- Are there any reports of health hazards, such as sewage failures?
- Describe how any foreseeable regulatory change(s) or new regulations coming into effect may affect system compliance.
- Describe the system operator requirements.
- Are facility operations and design adequate for ensuring regulatory compliance?
- Does the facility design meet process reliability and redundancy requirements?
- Are the short-term and long-term waste management options compliant?
- Describe the processes in place for record keeping and system monitoring.
- Is there sufficient water supply reserved under license for future system expansion?

3.6 CATEGORY FOUR—OPERATIONAL RISK

Water systems are complex operations that must be designed effectively to meet the required level of service. They require trained operators and effective management, as well as comprehensive operations and maintenance practices to ensure that operational objectives are being met. The ways in which infrastructure is managed and operated on a day-to-day basis can have a significant impact on the quality of drinking water and the condition of the receiving environment.

Risks to public and environmental health from water and wastewater systems can originate from operational error, due to factors such as system design, operator error, undocumented operations and maintenance procedures, or variable influent water quality, to name a few.

In this operational risk category, there are risk factors related to infrastructure design and how personnel operate the infrastructure, as well as risk factors related specifically to drinking water and wastewater systems.

The following sources of risk can be considered when assessing the operational risk to water systems:

- Effective knowledge management is critical for facility and infrastructure operations.
- Appropriate annual funding and revenue sources is required for effective operations.
- System design and operations must meet the objectives of regulatory compliance.
- Regulatory changes can impact how a water systems plant is operated and determine whether the infrastructure can meet the required standards.

- Climate change impacts—including flooding, drought, and hazards—may impact the operation of water system components, such as stormwater systems, treatment plant, distribution systems, and dams.
- System monitoring and record keeping is critical to ensuring that infrastructure is functional and performing as intended, and for identifying any system upsets.
- System design, age, and capacity can be indicative of future failure points in the infrastructure. Consider designing for emergency power, remote monitoring, operator safety (e.g., confined spaces), public safety (e.g. hazardous chemical release), and process reliability.

The following sources of risk are specific to drinking water systems and should be considered if applicable:

- The water source in an operational context refers to the variable conditions that affect the supply (including quantity and availability) and treatment of water. It includes raw water quality, raw water diversion, conveyance, and infrastructure including dams, spillways, screening, well heads, and pump stations.
- Treatment process refers to each drinking water treatment step, its contribution to regulatory compliance, and the effectiveness of its design. The criticality of each treatment step and the effect of failure should be considered.
- Water distribution networks rely on the effectiveness of the chlorine residual, the reservoir water age, the cross-connection control, the pipe material, and any additional water quality monitoring for the disinfection of by-products, lead, copper, or other distribution related issues.

The following sources of risk are specific to wastewater systems and should be considered if applicable:

- Sewer networks can be a risk to wastewater systems if significant inflow and infiltration (I&I) combined with sewer overflows, cross-connections, or failures, are evident.
- The influent source can be a risk to wastewater plant operations if deleterious substances are allowed to enter the system, which can upset plant processes or degrade effluent quality.
- Treatment process refers to each wastewater treatment step, its contribution to regulatory compliance, and the effectiveness of its design. The criticality of each treatment step and the effect of failure should be considered.
- Biosolids and residuals management can be a risk to wastewater systems, due to the expense, public acceptance, and whether disposal options are viable long term.

Common tools to manage operational risk may include but are not limited to:

- *Design Guidelines for Drinking Water Systems in British Columbia* (Ministry of Health 2023)
- Standard operating procedures (for drinking water and wastewater)
- Record drawings (for drinking water and wastewater)
- Maintenance records and data (for drinking Water and wastewater)
- Emergency management plan (for watershed, drinking water, and wastewater)
- Water master plan (for drinking water)
- Liquid waste management plan (for wastewater)
- Facility master plan (for drinking water and wastewater)
- *Comprehensive Drinking Water Source-to-Tap Assessment Guideline* (Ministry of Healthy Living and Sport 2010)

- Integrated stormwater management plan (for stormwater)
- Cross Connection Control Program (BC Water & Waste Association) (for drinking water and wastewater)
- Water conservation plan (for watershed and drinking water)
- Source control bylaw (for wastewater)
- Inflow and infiltration reduction program (for wastewater)
- Biosolids/residuals management plan (for drinking water and wastewater)
- Hazard & Operability Analysis (HAZOP) (Product Quality Research Institute) (for drinking water and wastewater)
- Green rainwater infrastructure (for stormwater)
- Water reuse infrastructure (for wastewater)
- Receiving environment assessment (for wastewater and watershed)
- Operating plan (for wastewater)
- Operator certification
- Operator training

Discussion points to help assess operational risk:

- Describe the processes in place for evaluating and managing operational risk to the water system.
- Is the operation and maintenance manual up to date, readily accessible, easily understood, and used by staff?
- Do variable influent sources make it challenging to consistently meet regulatory requirements?
- Describe any history of water shortages, flooding, or discharge of deleterious materials to the receiving environment.
- Has green rainwater infrastructure been considered to manage storm water?
- Describe the regular maintenance practices for drinking water distribution and sewer networks.
- Describe the processes for maintaining system records, such as record drawings and operational data. Are system records easily accessible?
- Are there regulatory changes which may impact system operations?
- Does system design incorporate redundancy and/or reliability criteria?
- Describe the safety and emergency response protocols.
- Are spare parts, back-up power, or other essential items accessible in case of emergency?
- What are the backup options for the management of biosolids and water treatment residuals?
- Describe the training opportunities for operators and staff to maintain and update their skills.
- Are the annual operations and maintenance budgets appropriate?
- Are cross connection control programs in place for drinking water systems and sewer collection systems?
- Describe the operating procedures in place to report and control spills of deleterious substances into receiving waters.
- Is there a contingency fund in place for operational emergencies?
- Do all of the water systems operators have emergency plans in place?

3.7 CATEGORY FIVE—WATERSHED RISK

Water systems function within shared watersheds, whose integrated land and water use impact not only the quality and quantity of the water but also the public and environmental health. When considering watershed risks, both surface and groundwater sources should be addressed.

The following sources of risk can be considered when assessing the watershed risk to water systems:

- The water source of a watershed in terms of influence, vulnerability, source water quality, the watershed's variability with annual precipitation levels, and the changes in how water storage is released due to climate change or manmade structures. Relevant studies and ongoing programs should be referenced.
- Agricultural, recreational, municipal, and industrial land use activity, including ranching, logging, forestry, and mining in a watershed, can lead to disturbances and potential sources of pollution to the environment or public water supply. Ecosystems requirements must be considered (for example, minimum stream flow for a fish habitat must be maintained when using a stream as a water supply).
- Residential, commercial, agricultural, and industrial development pressure in a watershed can lead to competition for water resources and reduced permeability of surfaces and can be a source of pollution, especially from storm water runoff.
- Geographical, topographical, and geological features such as steep, eroded banks or roads can increase sediment in a watercourse, reducing its quality.
- Natural hazards and climate change impacts—such as flood, drought, wildfire, and saltwater intrusion—can impact the quantity and quality of water available in the watershed.

Common tools to manage watershed risk may include but are not limited to:

- Source protection plan
- Watershed protection plan
- *Guidance Document for Determining Ground Water at Risk of Containing Pathogens (GARP)* (Ministry of Health, Health Protection Branch 2015)
- *Professional Practice Guidelines—Assessment of Groundwater at Risk of Containing Pathogens (GARP)* (Engineers and Geoscientists BC 2019)
- Groundwater vulnerability assessment
- Land use planning
- Integrated stormwater management plan
- Climate change risk assessment or adaptation plan
- Natural asset management inventory
- *Comprehensive Drinking Water Source-to-Tap Assessment Guideline* (Ministry of Healthy Living and Sport 2010)
- Indigenous Guardians Program

Discussion points to help assess watershed risk:

- Describe the processes in place for identifying, assessing, and managing risks to the watershed.
- How does commercial, industrial, agricultural, and/or residential development influence the watershed?
- Describe the history of flooding or drought in the watershed.
- Describe how climate change might impact the watershed.
- Describe how a natural disaster might impact the watershed.
- Are there opportunities to collaborate with other communities or watershed groups to manage shared water resources?
- Is there a shared watershed management relationship with local communities?
- Describe the relationship with water users and the public.

3.8 CATEGORY SIX—COMMUNICATION RISK

The water systems managers must be accountable to the public by transparently and effectively communicating with its immediate users, shared watershed groups, neighbouring communities, and regulators. Risks to public and environmental health may occur when communication channels do not exist or are poorly defined. Poor communication due to a lack of information or misinformation, or both, can lead to false perceptions or misunderstandings. Decision making, funding, and trust may suffer in this environment, which can reduce the ability of the system to respond effectively and efficiently.

The following sources of risk can be considered when assessing communication risk to water systems:

- Effective communication with users is crucial for conveying various aspects of service to ensure public health and environmental protection, service costs, instances of non-compliance, water restrictions during dry months, and information about major projects. This communication is essential to maintain trust in the safe and reliable delivery of the service.
- Effective communication with watershed groups and other users is important for collaborative management of the resource.
- Early and regular engagement and collaboration with local Indigenous communities, if applicable, is critical, as they are often Rights Holders of the resource.
- Effective communication with regulatory agencies is essential during non-compliance events, for receiving technical support, guidance, and securing senior government funding support.

Common tools to manage communication risk may include but are not limited to:

- Guidance for communicating with water users
- Communication protocols
- Public consultation policies
- Education programs

Discussion points to help assess communication risk:

- Describe the processes in place for evaluating and managing communication risks to the water system.
- Describe the communication channels in place with local communities, partners, and interest-holders, as applicable.
- Describe the relationships with the regulators, government ministries, Chiefs, councilors, directors, water users, and the public. Is there a common understanding from these groups of the risks that need to be managed?
- Describe the protocols and communication channels in place for emergencies or unplanned events.
- Are there emergency communication protocols and mutual aid agreements in place with neighbouring communities and the Ministry of Emergency Management and Climate Readiness?
- Describe the public consultation policies in place for major capital projects.
- Describe the organization's information technology security protocol.
- What kind of information about the water system is made available and accessible to customers?
- Describe the relationship with local Indigenous communities, if applicable.
- Describe the relationships with watershed groups and other local users.
- Consider any history of tensions around drinking water supply or wastewater management (e.g. biosolids and residuals disposal, watershed use, water rates).

3.9 CATEGORY SEVEN—STRATEGIC RISK

Strategic decision making goes into planning, designing, and delivering water and wastewater systems, which are generally designed to last 50 to 100 years and are major community investments. If these enterprise-level considerations are not considered strategically, they can result in political liabilities, sources of serious public mistrust, and legal disagreements. The value in water systems must be apparent for ongoing public, political, and financial support.

The following sources of risk can be considered when assessing strategic risk to water systems:

- Total system costs can be significant — particularly for smaller communities —which may be heavily scrutinized. Funds for water systems must be strategically appropriated to ensure good investments over the long-term.
- The management of non-compliances can have a major impact on public perception and the trustworthiness of the water supplier.
- Relationships and partnerships with watershed groups, other utilities, Indigenous communities, private entities, and other interested parties are important for maintaining trust in the water system, and to advance regional initiatives. Distinctions-based Rights of Indigenous Peoples often include inherent Rights to own, use, develop, and control lands and resources within their territories in British Columbia (BC).

- Managing public perception and reputation is important for maintaining trust in the quality of the drinking water being provided, treated wastewater being discharged, reclaimed, or reused, and stormwater being discharged.
- Demand from industrial, commercial, recreational, and residential growth and development can impact system performance, design life, and natural resource management.
- The level of service provided by a water system Owner can influence how projects are delivered and whether services are delivered by the public or private sector. This should also be considered with respect to public expectations for service provided.

Common tools to manage strategic risk may include but are not limited to:

- Official community plans
- Project delivery methods
- Growth management planning
- Strategic planning documents
- Asset management plans

Discussion points to help assess strategic risk:

- Describe the processes in place for evaluating and managing strategic risks to the water system.
- Describe the relationships and partnerships in place with local watershed groups and communities, as applicable.
- What protocols are established to notify and engage with the public when required?
- Has the water system been a point of public scrutiny?
- Will industrial, commercial, or residential development have an impact on the quality or quantity of drinking water or wastewater?
- How does the public perceive the trustworthiness of their drinking water and wastewater systems?
- Have natural assets been considered?
- Is there a decision-making process for determining project delivery methods?
- Does the public understand the value of drinking water and wastewater system services?

3.10 CATEGORY EIGHT—RESILIENCE RISK

Water systems are exposed to threats that have the potential to cause serious harm. Resilience risks refer to events which are unplanned, infrequent, and challenging to manage and mitigate. Natural disasters such as floods and droughts can have major consequences associated with their occurrence, but happen so infrequently that they may not be part of day-to-day considerations. Climate change is changing the severity and frequency of rainfall, drought, and major flooding events.

It is important to note that assessing resilience risks is a specialized branch of risk management, as it involves events where the likelihood of occurrence varies with a defined threshold of a given hazard, therefore the perceptions of the consequences at different thresholds can vary significantly.

It also involves events where the likelihood of occurrence may be very low, but the consequences are severe. For example, a significant earthquake has a low likelihood of occurrence but can be associated with severe consequences. Our perception of the risk posed by the earthquake, as well as how much risk we are willing to accept from that earthquake can vary significantly depending on who you ask and their historical experiences and biases.

Given the above, the following sources of risk can be considered when assessing resilience risk to water systems:

- Flood and drought may be considered a risk if the severity of the flood or drought is not planned for or exceeds design values (e.g. 200-year return period).
- Climate change impacts may be acute or chronic and could include changes in frequency, intensity, and duration of drought, pluvial or fluvial flooding, increased rate of permafrost thawing, increased magnitude and frequency of wildfires and landslide/erosion, and sea level rise or saltwater intrusion in coastal communities.
- Water system security as it relates to cybersecurity, vandalism, or crime that may impact public or environmental health.
- Liabilities associated with catastrophic events, such as major public health or receiving environment impacts.
- Major hazards such as wildfire, earthquake, landslide, flood, or tsunami.

Common tools to manage resilience risk may include but are not limited to:

- Emergency management plan
- Hazard, risk, and vulnerability assessments
- Response and recovery plan
- Mutual aid agreements
- Critical infrastructure assessment
- Post-disaster design requirements
- Floodplain mapping
- Climate change risk assessments or adaptation plans.

Discussion points to help assess resilience risk:

- Describe the processes in place for evaluating and managing resilience risks to the water system.
- Where is the system vulnerable to vandalism, cybersecurity threats, or criminal acts?
- What is the liability if regulatory requirements are not met?
- What critical system components are subject to flooding, wildfire, or other natural disasters? Are critical system components designed with resilience in mind?
- Describe water/wastewater system start-up procedures following a natural disaster.
- Describe the potential impacts to the water systems due to climate change.
- Describe the mutual aid relationships in place for emergency response.
- Describe the level of risk acceptable to the system.
- Describe the asset ownership and who ultimately holds responsibility for the risk.

4.0 QUALITY MANAGEMENT IN PROFESSIONAL PRACTICE

As a One Water System Risk Management Plan (WSRMP) is prepared by a Qualified Professional, it is subject to Engineers and Geoscientists BC's Quality Management requirements. Qualified Professionals must also be aware of any additional quality management requirements from other sources that are relevant to their work. The following sections address the quality management obligations that apply to a Qualified Professional's work when developing a WSRMP.

4.1 ENGINEERS AND GEOSCIENTISTS BC QUALITY MANAGEMENT REQUIREMENTS

Engineering/Geoscience Professionals must adhere to applicable quality management requirements during all phases of the work, in accordance with the Engineers and Geoscientists BC Bylaws and quality management standards.

To meet the intent of the quality management requirements, Engineering/Geoscience Professionals must establish, maintain, and follow documented quality management policies and procedures for the following activities:

- Use of relevant professional practice guidelines
- Authentication of professional documents by application of the professional seal
- Direct Supervision of delegated professional engineering or professional geoscience activities
- Retention of complete project documentation
- Regular, documented checks using a written quality control process
- Documented field reviews of engineering or geoscience designs and/or recommendations during implementation or construction
- Where applicable, documented independent review of structural designs prior to construction
- Where applicable, documented independent review of high-risk professional activities or work prior to implementation or construction

Engineering/Geoscience Professionals employed by a Registrant firm are required to follow the quality management policies and procedures implemented by the Registrant firm as per the Engineers and Geoscientists BC's Permit to Practice Program.

For more information on using professional practice guidelines, refer to the *Quality Management Guide—Guide to the Standard for the Use of Professional Practice Guidelines* (Engineers and Geoscientists BC 2023b), which contains guidance for how an Engineering/Geoscience Professional can appropriately depart from the guidance provided in professional practice guidelines.

Engineering/Geoscience Professionals are required to authenticate (seal with signature and date) all documents, including electronic files, that they prepare or deliver in their professional capacity to others who will rely on the information contained in them.

For WSRMP documentation, this includes authentication of professional responsibility for the work carried out, and the reliability of the information contained within the report (including any risk assessments). The Qualified Professional is required to state their sources of information for the report and complete an appropriate level of due diligence on the reliability of the information and its source. It is important to note that this is not intended to imply that the Qualified Professional is taking professional responsibility for the water system (or water systems, components, or aspects thereof), nor is the Qualified Professional taking professional responsibility for the implementation of their recommendations or action items. For more information on authentication, refer to the *Quality Management Guide—Guide to the Standard for the Authentication of Documents* (Engineers and Geoscientists BC 2023c).

For additional information on Quality Management requirements for Direct Supervision, retention of project documentation, documented checks, field reviews, or independent reviews, refer to the appropriate *Quality Management Guides* published by Engineers and Geoscientists BC.

4.2 OTHER QUALITY MANAGEMENT AND BYLAW REQUIREMENTS

Engineering/Geoscience Professionals must also be aware of any additional quality management requirements from other sources that are relevant to their work, which may include but are not limited to:

- legislation and regulations at the local, regional, provincial, and federal levels;
- policies of Local Community Governing Bodies at the local, regional, provincial, and federal levels;
- agreements and service contracts between Clients and Engineering/Geoscience Professionals or their firms; and/or
- standards for engineering or geoscience firms, particularly those that apply to quality management system certification, such as the ISO 9000 family (International Organization for Standardization).

Engineering/Geoscience Professionals should assess any areas of overlap between the Engineers and Geoscientists BC quality management requirements and the requirements of other applicable sources.

Where there are conflicts between requirements, Engineering/Geoscience Professionals should negotiate changes or waivers to any contractual or organizational requirements which may conflict with requirements of legislation, regulation, or the Engineers and Geoscientists BC Code of Ethics.

Generally, no contractual obligation or organizational policy that may apply to an Engineering/Geoscience Professional will provide justification or excuse for breach of any of the Engineering/Geoscience Professional's obligations under any legislation, regulation, or the Engineers and Geoscientists BC Code of Ethics.

Where such conflicts arise and cannot be resolved, Engineering/Geoscience Professionals should consider seeking legal advice from their own legal advisers on their legal rights and obligations in the circumstances of the conflict, and they may also seek practice advice from Engineers and Geoscientists BC on any related ethical dilemma that they may face under the circumstances.

As established in Section 58 of the *Professional Governance Act* and in principle 9 of the Engineers and Geoscientists BC Code of Ethics, Registrants must report to the appropriate authorities if they have reasonable or probable grounds to believe that:

1. the continued practice of another Registrant might pose a risk of significant harm to the environment or to the health or safety of the public or a group of people; or
2. a Registrant or another individual has made decisions or engaged in practices which may be illegal or unethical.

If during the development, review, and/or attestation of a WSRMP, a Registrant identifies a risk that poses an imminent threat to human health and/or the receiving environment, the Registrant has a duty to immediately report the risk to the Owner and/or other appropriate authorities.

4.3 PRACTICE ADVICE

Engineers and Geoscientists BC provides their Registrants and others with assistance related to professional practice and ethics. Practice advisors at Engineers and Geoscientists BC can answer questions regarding the intent or application of the professional practice or quality management aspects of these guidelines.

To contact a practice advisor, email practiceadvisor@egbc.ca.

5.0 PROFESSIONAL REGISTRATION AND EDUCATION, TRAINING, AND EXPERIENCE

5.1 PROFESSIONAL REGISTRATION

Engineering/Geoscience Professionals have met minimum education, experience, and character requirements for admission to their professions. However, the educational and experience requirements for professional registration do not necessarily constitute an appropriate combination of education and experience for the development of One Water System Risk Management Plans (WSRMPs). Professional registration alone does not automatically qualify an Engineering/Geoscience Professional to take professional responsibility for all types and levels of professional services in this professional activity.

It is the responsibility of Engineering/Geoscience Professionals to determine whether they are qualified by education, training, and/or experience to undertake and accept responsibility for carrying out the development of WSRMPs (Code of Ethics Principle 2).

5.2 EDUCATION, TRAINING, AND EXPERIENCE

WSRMP development, as described in these guidelines, requires minimum levels of education, training, and experience in many overlapping areas of engineering and geoscience.

Engineering/Geoscience Professionals who take responsibility for the development of WSRMPs must adhere to the second principle of the Engineers and Geoscientists BC Code of Ethics, which is to "practice only in those fields where training and ability make the registrant professionally competent" and, therefore, must evaluate their own qualifications and must possess the appropriate education, training, and experience to provide these services.

Integration of multiple disciplines is critical for the successful development of WSRMPs, as a typical WSRMP will require the application of a wide range of understanding of watersheds, drinking water, and wastewater systems. A Qualified Professional for this work will likely have significant experience in the planning, design, and construction of drinking water and wastewater infrastructure for communities.

The Qualified Professional should have knowledge of the interdependencies between disciplines and among other professions relevant to completing comprehensive water system level risk assessments in British Columbia (BC).

Before undertaking work as a Qualified Professional in developing WSRMPs, the Qualified Professional should be able to demonstrate competency in the following areas, as applicable:

- integrated water resource management concepts;
- water and/or wastewater system design concepts;
- water and/or wastewater regulatory requirements;
- water and/or wastewater system operation, maintenance, and monitoring concepts;
- asset management, system funding, and cost recovery concepts;
- public communication and consultation strategies;
- local government, First Nation, provincial, and/or federal legislative environments; and
- risk assessment methodologies.

Typically, a Qualified Professional will develop this knowledge through a combination of university courses, continuing education courses, industry conferences, and project work of increasing complexity.

6.0 REFERENCES AND RELATED DOCUMENTS

Documents cited in these guidelines appear in Section 6.1 Legislation, Section 6.2 References, and Section 6.3 Programs and Resources.

Related documents that may be of interest to users of these guidelines but are not formally cited elsewhere in this document appear in Section 6.4 Related Documents.

6.1 LEGISLATION

Declaration on the Rights of Indigenous Peoples Act [SBC 2019], Chapter 44.

Drinking Water Protection Act [SBC 2001], Chapter 9.

Environmental Management Act. Municipal Wastewater Regulation [B.C. Reg. 87/2012].

Professional Governance Act [SBC 2018], Chapter 47.

Public Health Act [SBC 2008], Chapter 28.

Water Sustainability Act [SBC 2014], Chapter 15.

6.2 REFERENCES

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7.0 APPENDICES

Appendix A: Risk Analysis 34

Appendix A: Risk Analysis

Risk analysis is the process of calculating the likelihood of an event occurring and the consequence if it were to occur. The product of the likelihood and consequence is the risk rating.

Likelihood is the chance that the risk event will occur. In most cases, likelihood is a subjective that could be established via desktop research, and in consultation with the project team. Consequence is the degree of severity with respect to goals or values should the risk event occur.

The risk register is a summary of the risks identified through the WSRMP process. The following risk analysis approach from the *Risk Management Guideline for the B.C. Public Sector* (Province of British Columbia Chief Risk Office 2022) can be used, however, the selection of a risk analysis method or approach is at the discretion of the Owner and/or the Qualified Professional.

Table 4 provides guidance for calculating risk likelihood and Table 5 provides guidance for calculating risk consequence.

Table 4: Risk Likelihood Scoring (Adapted from: Risk Management Guideline for the B.C. Public Sector, Province of British Columbia Chief Risk Office 2022)

SCORE	CRITERIA	PROBABILITY
5	Almost Certain	80-99% or once a year or more frequently
4	Likely	61-79% or once every three years
3	Possible	40-60% or once every five years
2	Unlikely	11-39% or once every 15 years
1	Almost certain not to happen	0-10% or once every 25 years

Table 5: Risk Consequence Scoring (Adapted from: Risk Management Guideline for the B.C. Public Sector, Province of British Columbia Chief Risk Office 2022)

SCORE	IMPACT	DESCRIPTION
5	Catastrophic	• Major problem from which there is no recovery • Loss of critical infrastructure • Critical impacts to environment • Loss of life
4	Major	• Significant event which has a long recovery period • Loss of infrastructure, major impacts to public health or environment
3	Moderate	• Important impediment to objectives of maintaining public health and environmental quality • Recovery from event requires cooperation across departments • May generate media attention
2	Minor	• Routine difficulties associated with water and wastewater systems, program planning and operations • Can be dealt with at a department level
1	Insignificant	• Negligible impact to public or environmental health • Can be dealt with internally • No escalation of issue required

The risk rating is the product of likelihood and consequence. Table 6 provides guidance on how to calculate the risk rating.

Table 6: Calculating the Risk Rating (Adapted from: Risk Management Guideline for the B.C. Public Sector, Province of British Columbia Chief Risk Office 2022)

LIKELIHOOD					
5	LOW	MEDIUM	HIGH	EXTREME	EXTREME
4	LOW	MEDIUM	HIGH	HIGH	EXTREME
3	LOW	MEDIUM	MEDIUM	HIGH	HIGH
2	LOW	LOW	MEDIUM	MEDIUM	MEDIUM
1	LOW	LOW	LOW	LOW	LOW
	1	2	3	4	5
CONSEQUENCE					

LIKELIHOOD X CONSEQUENCE			
SCORE	0–5	=	LOW
SCORE	6–10	=	MEDIUM
SCORE	12–16	=	HIGH
SCORE	20–25	=	EXTREME

The risk rating can inform the priority to which the risk must be attended to. There should be special attention paid to risks that have a high consequence and a low likelihood of occurrence. Actions to manage risks should be defined based on the Owner's risk tolerance or willingness to accept a risk and all risks should be prioritized. The framework in Figure 4 can be used to evaluate risks and prioritize the recommended actions.

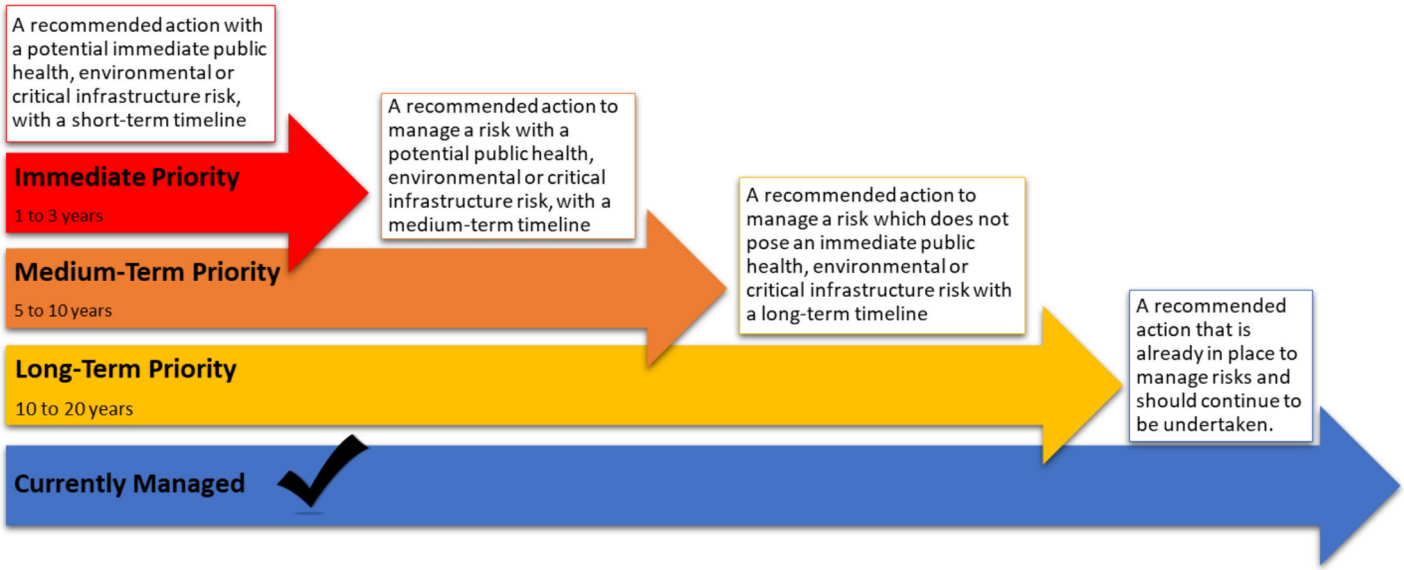

Figure 4: Action prioritization

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