GUIDE TO SOURCE WATER PROTECTION PLANNING

Protecting Sources of Drinking Water in Alberta

ALBERTA WATER COUNCIL

About the Alberta Water Council

The Alberta Water Council (AWC) is a multi-stakeholder partnership with members from governments, industry, and non-government organizations. All members have a stake in water.

The AWC is one of three partnerships established under the *Water for Life* strategy: the others are Watershed Planning and Advisory Councils and Watershed Stewardship Groups.

The AWC regularly reviews the implementation progress of the *Water for Life* strategy and champions the achievement of the strategy's goals. The AWC also advises the Government of Alberta (GoA), stakeholders, and the public on effective water management practices, solutions to water issues, and priorities for water research. However, the GoA remains accountable for implementing the *Water for Life* strategy and continues to administer water and watershed management activities throughout the province.

Alberta Water Council
14th Floor, Petroleum Plaza South Tower
9915-108 Street
Edmonton, AB T5K 2G8

Tel: 780-644-7380
Email: info@awc-casa.ca
Web: www.awchome.ca

ISBN 978-1-4601-4637-8
https://open.alberta.ca/publications/9781460146378

Contents

List of Tables

List of Figures

Abbreviations

AWC	Alberta Water Council
AWWA	American Water Works Association
DWSP	Drinking Water Safety Plan
GoA	Government of Alberta
GWUDI	Groundwater Under the Direct Influence of Surface Water
IAP2	International Association of Public Participation
MEERA	My Environmental Education Evaluation Resource Assistant
SWP	Source Water Protection
WPAC	Watershed Planning and Advisory Council
WSG	Watershed Stewardship Group

Introduction

Public, private, and individual drinking water providers in Alberta strive to provide access to safe, reliable drinking water at affordable rates. The challenges of growing populations, aging infrastructure, climate change, and limited water supplies have increased the need for a more integrated, collaborative approach to minimize the costs of water treatment, reduce public health risks, and protect sources of drinking water.

> "I think once we understand each other a bit more clearly, we can tell the rest of the people, this is what's happening to our water and how to take care of it — because it`s taken care of us up till now"
>
> *Violet Poitras, Nakota/Cree Elder, Paul First Nation*

Purpose and Intended Users

This guide provides advice on how to protect drinking water sources through developing a Source Water Protection (SWP) plan. It is intended for drinking water providers (i.e., public, private, and individual) and should be used together with AWC's *Protecting Sources of Drinking Water in Alberta: Companion Document*. Additional groups that may find this guide useful include municipalities, drinking water providers (utilities), Indigenous communities, Watershed Planning and Advisory Councils (WPACs), Watershed Stewardship Groups (WSGs), and other interested groups.

Who are WPACs and WSGs?

Multi-stakeholder partnerships are recognized under Alberta's *Water for Life* Strategy. WPACs are independent, non-profit organizations that report on watershed health and facilitate collaborative planning, education, and stewardship at a watershed scale. For more information, see map on page 2.

WSGs take community-level action to safeguard our water sources. These groups are community-led, volunteer-based partnerships actively engaged in environmental stewardship of their watershed at a local level.

Alberta Environment and Parks

WATERSHED PLANNING & ADVISORY COUNCILS

- MUNICIPALITIES
- WATERSHED PLANNING & ADVISORY COUNCILS
- FIRST NATION RESERVES

Source Water Protection Defined

SWP is a risk-management process designed to maintain or improve the conditions of water through proactive, collaborative identification, validation, assessment, and management of risk. The quality and quantity of drinking water is influenced by activities that occur in the watershed that supplies the drinking water system.

In Alberta, SWP is a voluntary and collaborative process that has been undertaken by several groups. SWP is a component of broader water management in which a suite of approaches is implemented as a cost-effective way to ensure safe and secure water quality and quantity conditions. It is most closely linked to drinking water safety. Achieving effective SWP is a complex task that requires careful consideration of many different water uses. Viewing SWP as a component of integrated watershed management is one way of addressing this challenge. There is no single solution to the challenge of protecting sources of drinking water. SWP can be achieved in many ways, and the choices made in specific regions or watersheds about the balance of regulatory and non-regulatory tools should reflect local needs, issues, and capacities.[1]

1 Water Policy and Governance Group, 2010. *Tools and Approaches for Source Water Protection in Canada*. Governance for Source Water Protection in Canada. Report no. 1. Accessed September 2019. Available online: http://mynanbo.org/public/documents/outils/uploaded/qvkntzwx.pdf

How to Use this Guide

The information in this guide is not prescriptive and can be adapted to the local needs and conditions. This guide was developed based on a review of several documents and with expertise from Alberta and other jurisdictions. Supporting case studies, examples, and key factors for success specific to Alberta are documented. Section 1 provides an overview of the main steps in creating a SWP plan and was adapted from the *SWP Operational Guide to the American Water Works Association's Standard G300*. Section 2 gives a summary of conclusions, and Section 3 contains other relevant resources that can support SWP initiatives. SWP-related legislation and policies in Alberta are described in Section 4.

Protecting sources of drinking water is challenging, particularly for smaller public, private, and individual drinking water providers that may not have the capacity or resources to spearhead a SWP initiative on their own. However, drinking water providers and others can collaborate by pooling their resources together to address common risks in their source water areas. Background information about SWP in Alberta and the project team's findings are detailed in AWC's *Protecting Sources of Drinking Water in Alberta: Companion Document*.

American Water Works Association's G300 SWP Standard

The American Water Works Association (AWWA) is an international, nonprofit, scientific, and educational society dedicated to providing total water solutions ensuring the effective management of water. They offer education to water professionals, advocate for safe and sustainable water, collect and share knowledge, and create volunteering opportunities. Their operational guide helps utility managers implement requirements established in AWWA G300 SWP. It helps utilities identify source water protection goals, produce action plans, implement the plans, and assess effectiveness. It includes worksheets, an extensive resource section, and case studies of successful source protection programs.

Background

As of 2013, drinking water providers regulated by Alberta Environment and Parks (AEP) are required to develop Drinking Water Safety Plans (DWSPs) for their water systems. DWSPs are a proactive method used by water providers for assessing risks to the source, treatment, storage, and distribution of drinking water. However, many communities lack the capacity and resources to manage risks to their drinking water sources. SWP planning can help drinking water providers and others to manage source water risks through a collaborative, multi-barrier approach. SWP is the first barrier in the multi-barrier approach that uses a series of barriers (e.g. risk management, monitoring, enforcement, education and stewardship actions) to ensure safe, clean drinking water, even if one barrier fails.

In 2017, the Government of Alberta requested that the Alberta Water Council develop tools and resources to support SWP in Alberta. As a result, a multi-sector project team was formed to document existing SWP approaches and provide guidance for protecting sources of drinking water in Alberta. Additional background information about SWP in Alberta and the project team's findings are detailed in AWC's *Protecting Sources of Drinking Water in Alberta: Companion Document*.

1.0 Steps in Source Water Protection Planning

"The care and responsibility we show for our water demonstrates much about our values including our level of concern for the quality of life for future generations."

Dr. Grant MacEwan, ninth Lieutenant Governor of Alberta

SWP is a site-specific and place-based process that will differ for each source water area, depending on the drinking water source, local conditions, and potential partners for collaboration, among other factors. Public, private, and individual drinking water providers may need to adapt their approach based on the information, resources, and tools available. However, a few key stages are common to most SWP planning processes. The AWWA Standard G300 for SWP outlines six steps for developing a successful SWP plan, which are illustrated in Figure 1.

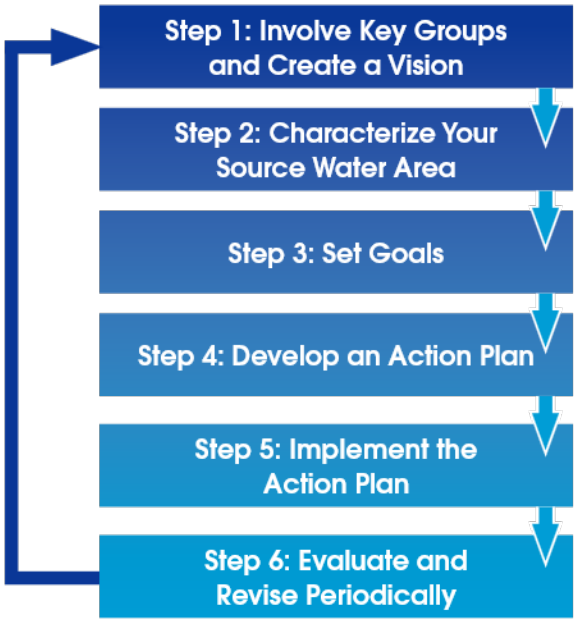
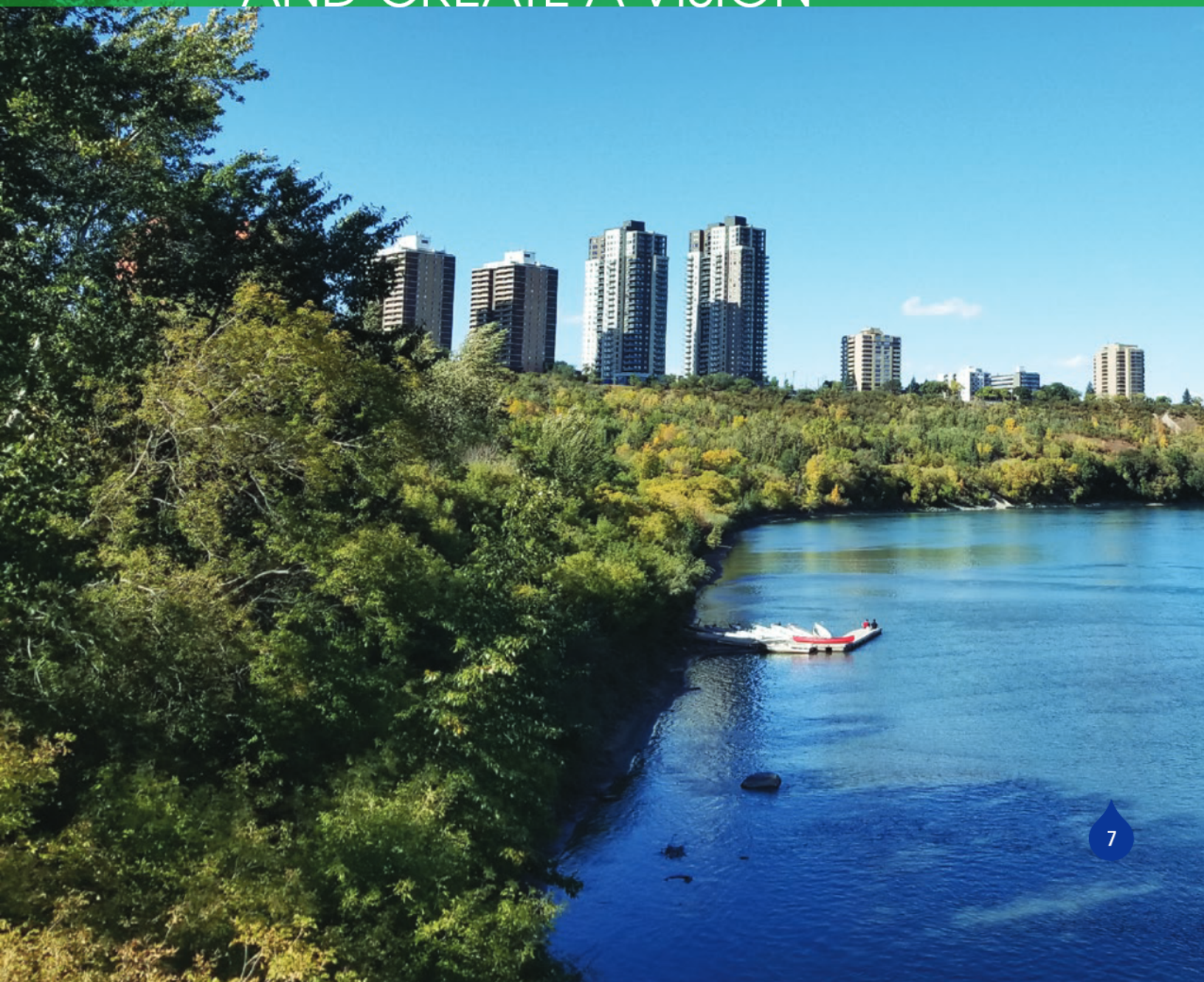


Figure 1: Components of a Successful SWP Program (Adapted from AWWA Standard G300)

Planning, collaboration, and ongoing evaluation are common to most SWP plans recognizing that the approach may have to be adapted and customized to address local needs, conditions, challenges, and opportunities. These following sections describes six key steps in more detail and offers key factors for success when undertaking each.

Step 1

INVOLVE KEY GROUPS AND CREATE A VISION



SWP should be a proactive process, but it often begins with the efforts of a concerned group in a source water area where there is an issue. Uncoordinated SWP efforts can be due, in part, to inadequate collaboration, which can lead to duplicated efforts among key groups in a source water area.

"I believe that involving council members and citizens from both the City and County also helped municipalities have a greater appreciation of the risks that exist to our water supply"

Jeremy Enarson, City of Camrose

1.1 Involve Key Groups

Before creating a vision, it is important to engage a representative group of interested partners by setting up a committee or advisory body. This group can then champion the SWP process, share information, and brainstorm ideas on how to tackle challenges and create opportunities. A useful and commonly used method for facilitating these meetings is the consensus based decision-making model. This model strives for agreement and allows diverse interests to be shared. In Alberta, SWP-focused groups are most often set up by drinking water providers or WPACs. A collaborative approach reduces costs and enhances the capacity and partner buy-in for proceeding with the planning process. WPACs and WSGs can provide facilitation and coordination support for these processes, depending on their staff capacity. The Red Deer River Municipal Users Group is an example of a collaboration focusing on SWP and working with the Red Deer River Watershed Alliance (see Case Study 1).

Case Study 1: Red Deer River Municipal Users Group Tackles SWP Collaboratively

During the adoption of the South Saskatchewan Water Management Plan in 2006, municipalities in the Red Deer River Basin started meeting to talk about the future of its water. Over time the municipalities decided to form an association that became official in 2008. Their purpose is to provide a forum for municipalities to both discuss water supply, use, and quality and to advocate for municipal interests in the supply, use, delivery, and quality of water. For information about this group, go to http://rdrmug.ca/.

Most SWP work is happening at the drinking water provider level in Alberta with input from various groups. Interested partners for a SWP group will differ by source water area, but should aim to include representatives from industry, non-government organizations, governments, individuals, and other key groups. Table 1 outlines potential groups that may be a part of the SWP process. The International Association for Public Participation (IAP2)'s planning stages provide helpful advice on how to engage these groups. For more information, go to www.iap2.org

Table 1: Potential SWP Groups to Engage

Industry	Non-Government	Government	Other
– chemical and petrochemical – irrigation – cropping – mining – oil and gas – forestry – livestock – power generation	– WPACs – WSGs – environmental groups – recreation groups – land trusts – agricultural groups – water co-operatives	– municipalities (e.g., planning, parks, environment, water, and transportation departments) – Government of Alberta – provincial authorities (e.g., the Alberta Energy Regulator and Alberta Health Services) – Government of Canada – Indigenous communities	– water utilities – landowners – neighbourhood associations – individuals – universities and colleges – golf courses – research groups (e.g., Alberta Innovates) – schools – campgrounds

This guide can also be used by Indigenous communities to complement their SWP efforts. Several Indigenous communities involved in SWP planning are using the federal *First Nations On-Reserve Source Water Protection Plan: Guide and Template*. These communities include Siksika Nation, Frog Lake Nation, Piikani Nation, Big Stone Cree Nation, Saddle Lake Cree Nation and others. Engaging Indigenous communities in SWP planning from an early stage and throughout the process is important to ensuring that their input is included. The City of Calgary's SWP plan acknowledges the importance of incorporating the Niitsitapi (Blackfoot), the Nakota Sioux (Stoney) Nation, and the Tsuut'ina (Beaver)

people's perspectives in SWP efforts. The City encourages ongoing dialogue and collaboration for implementing its SWP plan. Case Study 2 is another example of collaboration with Indigenous peoples.

Case Study 2: Collaboration in Action—Wabasca Area Source Water Protection Plan

Because of concerns about changes in local waterbodies as well as increasing pressure on water supplies, Bigstone Cree Nation, with support from First Nations Technical Services Advisory Group (TSAG), undertook the creation of a community SWP plan in the fall of 2015. In 2016, the Municipal District (MD) of Opportunity joined the project to create the Wabasca Area SWP plan. Since then, there has been collaboration between Bigstone Cree Nation, the MD of Opportunity, the Mighty Peace Watershed Alliance, and numerous post-secondary institutions on various water protection and management initiatives.

The following steps should be taken when setting up a SWP group:

- Define the goals and objectives for the group.
- Brainstorm a list of groups and individuals who should be involved.
- Invite representatives to join the group.
- Develop terms of reference.
- Develop communications and public participation plan.

It is important to clearly identify the lead agency (i.e., plan champion) who provides direction for public participation, outlines the roles and responsibilities of the committee, and defines how decisions are made. Plan champions would also spearhead developing, implementing, and evaluating SWP plans. This should be part of the terms of reference (ToR). For example, the Camrose Source Water Protection Plan has a detailed ToR that designated the Battle River Watershed Alliance as the plan champion. A support policy with incentives can ensure that the committee is representative of its source water area.

1.2 Create a Vision

A vision statement is an aspirational description of what your SWP group would like to achieve in the short term and long term. It acts as a guide when choosing current and future courses of action in a source water area while ensuring that SWP work stays true to its original intent. Once a SWP committee is up and running, it is useful to craft a collective vision for your source water area.

Working collectively with your SWP committee, the following tips can be helpful when creating a vision:

- Decide what you would like to achieve.
- Create a schedule and assign resources to manage the visioning process.
- Make a list of past achievements.
- Write a first draft.
- Gather input from others.
- Review, redraft, and revise as needed.
- Share your vision with others.
- Define clear roles and responsibilities defined with related accountabilities.
- Incorporate the multi-barrier concept.
- Ensure that the vision is science-informed, accountable, adaptive, and scalable.

Key Factors for Success

- ☐ Ensure that your vision for SWP reflects the unique needs, conditions, challenges, and opportunities of your source water area.
- ☐ Engage a representative group of partners when setting up your committee.
- ☐ Try to have the governing body of the drinking water system(s), municipalities, or elected officials approve the terms of reference and commit to assigning resources.
- ☐ Provide other means of engaging important groups outside of committee meetings (e.g., offline discussions, email copy lists, open houses).
- ☐ Have a clear, agreed-upon terms of reference and work plan to guide your committee's work and allocate enough time and resources.
- ☐ Follow the consensus based decision-making model to draw out diverse perspectives, find common ground, and make decisions collaboratively.
- ☐ Set up a support policy with incentives to encourage participation in SWP activities (e.g., funding to reimburse travel expenses, ability to claim honoraria).

For more resources related to involving key groups and creating a vision, see Section 3.

Step 2

CHARACTERIZE YOUR SOURCE WATER AREA

Before developing goals and a SWP plan, it is important to characterize your source water area by gathering information. The main tasks in characterizing your source water area are to delineate your source water area, synthesize data on the resource, and identify and assess its risks. This analysis will help your SWP committee identify, categorize, and prioritize drinking water quality and quantity risks, and develop SWP goals.

2.1 Delineate the Source Water Area

By clearly delineating (or identifying) the boundary of your source water area on a map, your group will better understand how local land features interact ecologically, hydrologically, and hydrogeologically with the drinking water source. Additionally, you can gauge how various types of land use (e.g., municipal, agricultural, irrigation, mining, and oil and gas) can guide your proposed SWP plan and which areas require more focus than others.

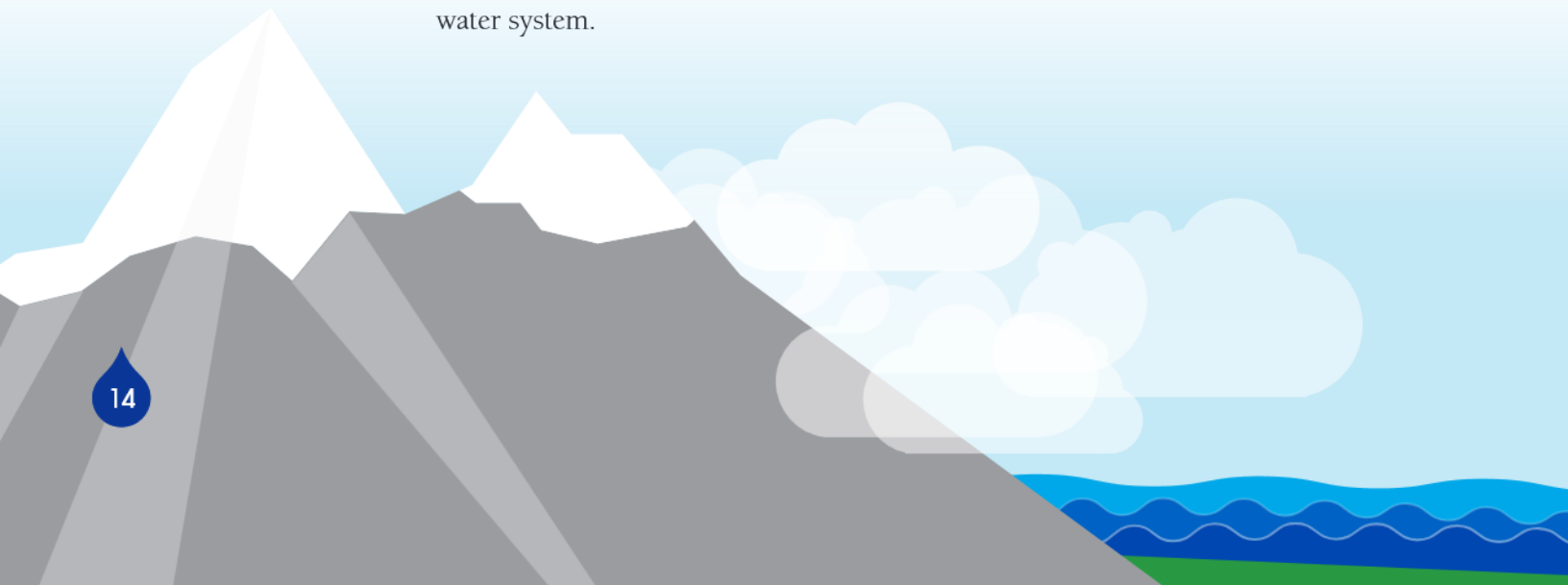
Your drinking water system should also be added to the map including the location of infrastructure such as surface water intake structures, groundwater wells, treatment plants, pumping and chlorination stations, and distribution systems. The identification of water intake structures may be subject to safety and security requirements, so discretion should be used when sharing this information externally.

Water Sources

Surface water refers to water found on the surface of the earth such as rivers, streams, reservoirs, lakes, ponds, canals, and wetlands.

Groundwater is found beneath the earth's surface in gaps and pore spaces between sand, gravel, sandstone, or other rocks.

The process of delineating a source water area varies based on the drinking water sources; different methods are needed depending on whether the sources are surface or groundwater. In some circumstances, key interactions between surface water and groundwater also need to be considered. Particular attention should be paid to areas near drinking water sources and the time that it may take for potential contaminants to reach the intake pipe of a drinking water system.



2.1.1 Surface Water

Watershed boundaries upstream of your intake location are often used when delineating the surface water source. To do this, determine the land area drained by water that flows into a surface water source, and where potential contaminants and other risks can be identified and mitigated.

Working with your SWP committee, complete the following tasks to delineate your surface water source:

- **Delineate the source water area** — Topographical maps and aerial photographs are used for this task with the assistance of an experienced technician capable of drawing boundary lines using elevation points around a source. Geographical Information Systems (GIS) can be used to produce maps of a source water area. The Canadian Council of Ministers of the Environment has put forward a few methods for delineating surface waters as described below. The delineation method selected may depend on the accuracy needed and the technical support or budget available.

  The area of land included in the delineation process may depend on the geography, land- use activities, land ownership, and jurisdictional boundaries. For example, some drinking water providers delineate the source water area to include the entire watershed upstream of the water intakes; others delineate the source water area using only their jurisdictional boundaries.

  Depending on the size of your source water area, you may also want to identify smaller "critical areas" as priorities to focus on for contaminant inventories and protection. For example, drinking water "intake protection zones" (in Ontario) and "watershed protection

Delineation Methods

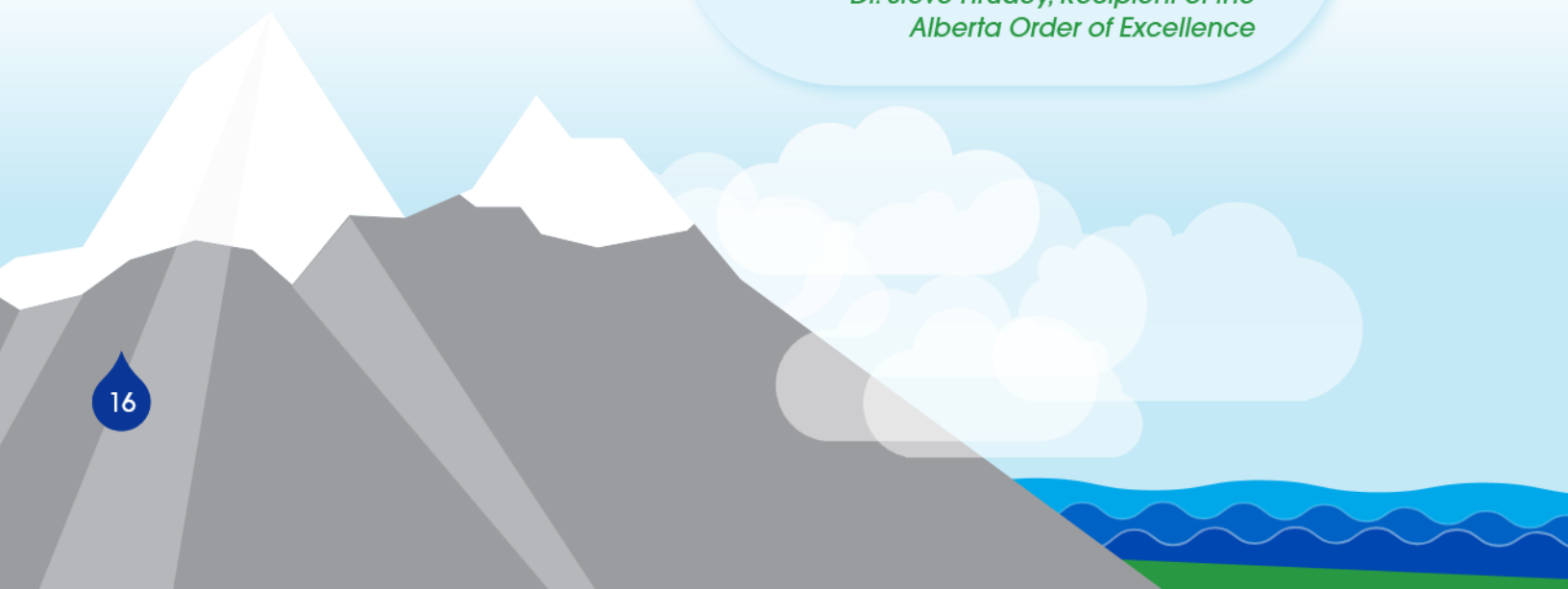
- *Topographic Boundaries*
  Topographic maps are used for establishing boundaries by following the perimeter of high contour lines that show the direction of overland water flow.
- *Streamflow Time of Travel*
  This method is based on the time it takes for a contaminant travelling at the same time as the velocity of a stream to reach the water intake point.
- *Setback/Buffer Zones*
  These zones are used as a means of reducing the impact of run-off on drinking water sources by filtering overland flow and encouraging groundwater infiltration. The typical width of a riparian buffer is 15 to 60 m depending on the degree of impact from land-based activities.

areas" (in Nova Scotia) are identified and prioritized for protection. In urbanized areas, storm water infrastructure and drainage catchments will need to be considered in the delineation because grading and urban development at the local level will often alter drainage catchment boundaries at watershed margins.

- **Obtain information about the physical features of your source** — Physical features include the topography of the land and location of your water source. You may also need to identify the effective drainage area (i.e., the area that regularly contributes run-off during flooding conditions at least once every two years). For example, the Town of Grande Cache's SWP Plan looked at surrounding elevations, relative relief, forest cover and type, daily average temperatures, snowfall averages, and normal annual precipitation as physical characteristics.
- **Obtain maps and information about the land** — Information about land-use activities, ownership, watershed boundaries, regional land-use boundaries, and municipal zoning is useful when characterizing the source water area and identifying potential risks. Potential sources of contamination or impacts to source waters (from run-off, irrigation canals, pipelines, roads, etc.) may also influence how the boundary is identified.

"Preventing source water from becoming contaminated is almost universally more cost effective than allowing water quality degradation and being required to implement additional treatment"

Dr. Steve Hrudey, Recipient of the Alberta Order of Excellence



2.1.2 Groundwater

Delineating a groundwater source requires the use of aquifer boundaries. Groundwater can be one of two types:

- **Groundwater Under the Direct Influence of Surface Water (GWUDI)** refers to groundwater sources (i.e., wells, springs, and infiltration galleries) where microbial pathogens can travel from nearby surface water to the groundwater source.
- **Groundwater** (also known as non-GWUDI) is typically deeper than GWUDI and may have a hydrologic connection with surface water over longer time frames.

For groundwater, the planning boundary may include a small area immediately surrounding a single water well or the entire aquifer system(s) that supplies water to a region. Determining appropriate scales at which groundwater sources should be identified may be difficult due to the limited knowledge of groundwater systems in some parts of Alberta. This is further complicated by the fact that groundwater aquifers are often not confined to watershed boundaries. In areas where groundwater is used or influences a source of drinking water, groundwater considerations should be included as an integral component of SWP plans. The draft Grimshaw Gravels Aquifer Source Water Protection Plan[2] is a living example of how drinking water from an aquifer can be managed through collaboration.

Delineating the area is usually done using mathematical or computer modelling based on site-specific hydrogeological data. Professional assistance from a qualified hydrogeologist or groundwater engineer is often needed to complete this work accurately. You may also want to identify specific "wellhead protection areas" as priorities to help manage risks based on the time it takes for groundwater to travel to the water well.[3]

2 Grimshaw Gravels Aquifer Management Advisory Association and Might Peace Watershed Alliance, 2018. Grimshaw Gravels Aquifer Source Water Protection Plan. Accessed September 2019. Available online: https://www.mightypeacewatershedalliance.org/projects/grimshaw-gravels-aquifer-source-water-protection-plan/

3 Nova Scotia Environment, 2004. Step 2: Delineate a Source Water Protection Area Boundary. Accessed January 2020. Available online: https://novascotia.ca/nse/water/docs/WaterProtectionPlanStep2.pdf

2.2 Identify and Assess Risks

Depending on your source water area, the drinking water source could be vulnerable to several contaminants and their associated risks. Identified drinking water risks, common practices, and risk-management approaches are detailed in Section 2.3 of the AWC's *Protecting Sources of Drinking Water in Alberta: Companion Document*. Risks identified by some drinking water providers include reliance on a single drinking water source, contaminants from flood run-off, and point sources of pollution from upstream activities. However, these sources of contamination and their risks may or may not apply to your specific source water area.

It is important to understand the type of land-use activities in your source water area and identify and assess the risk that each type poses to the drinking water source. Working with your SWP committee, three key steps can be taken as listed below:

- **Inventory land-use activities** — an inventory is a useful method of identifying land-use activities and their potential harmful impacts and risks to your drinking water source. Using GIS, land-use mapping is a valuable tool to obtain information about land-use activities in your source water area. In Alberta, the following information is available to help with this step:
  - provincial GIS files (available from Altalis)
  - GoA's GeoDiscover Alberta
  - GoA's Alberta Water Wells Web Application
  - state of the watershed reports from WPACs and WSGs
  - Alberta Biodiversity Monitoring Institute's land-use database
  - municipal development plans and municipal land-use data
  - municipal stormwater data
  - traditional ecological knowledge
  - Agriculture and Agri-Food Canada – Canada Crop Inventory
  - GoA's Environmental Site Assessment Repository

- **Identify risks and potential sources of contamination** — Preventing contaminants from entering a drinking water source is the first barrier in the multi-barrier approach. However, in some instances, mitigation or treatment options may need to be investigated. You should work with your SWP committee and use the inventory of land-use activities created in the previous step to accurately identify sources of contamination in your source water area. Water quantity and water quality monitoring data and information on potential sources of contamination can be obtained from the following websites:
  - Alberta River Basins (https://rivers.alberta.ca)
  - Surface Water Quality Data (www.alberta.ca/surface-water-quality-data.aspx)
  - Environmental Site Assessment Repository (soil and groundwater reports): www.alberta.ca/environmental-site-assessment-repository.aspx

Types of Contaminants Affecting Source Water Quality

The following is a list of contaminants that affect source water quality:

- biological — organisms in water that are referred to as microbes or microbiological contaminants (e.g., bacteria, viruses, and parasites such as *E. coli*, *Giardia*, and *Cryptosporidium*)
- chemical — elements or compounds that can be naturally occurring or anthropogenic (e.g., nutrients, pesticides, petroleum, metals, toxins produced by bacteria, and pharmaceuticals)
- physical — elements or compounds s that impact the physical appearance or properties of water sediment or organic material suspended in water (e.g., debris and suspended solids)
- radiological — chemical elements with an unbalanced number of protons and neutrons that form unstable atoms emitting ionizing radiations (e.g., plutonium, uranium, and caesium)

Examples of Activities and Events Affecting Source Water Quality and Quantity

The following is a list of activities and events that affect source water quality and quantity:

- drought
- floods
- wildfire
- land-use practices (e.g., agriculture, oil and gas, forestry, and mining)
- urban and linear development (e.g., roads, stormwater, powerlines, and pipelines)
- extent of water allocations and water reuse
- connectivity between groundwater and surface water

- **Assess the risk of each source of contamination** — After your SWP committee has identified potential threats to the drinking water source, the next step is to assess the risk each one poses so that appropriate management actions can be developed, implemented, and evaluated. The first step is to assign a numerical value that represents the probability of a specific risk happening. Then another value must be assigned to reflect the impact of each risk if it were to happen. Based on Alberta's Drinking Water Safety Plan Risk Scoring, Tables 2 and 3 demonstrate how this process is applied.

Table 2: Likelihood Table (Adapted from Alberta's DWSP Template)

Likelihood	Definition	Value
Not applicable	Does not apply in this water system.	0
Most unlikely	Conceivable but extremely small chance of happening in the next 4 to 5 years.	1
Unlikely	Is possible and cannot be ruled out in the next 4 to 5 years.	2
Medium	50/50 chance of happening in the next 4 to 5 years.	4
Probable	Would be expected to happen in the next 4 to 5 years but there is a small chance it may not.	8
Almost certain	Would be confident this will happen at least once in the next 4 to 5 years.	16

*Depending on the information available, SWP plans should also consider the likelihood of long-term (5 to 20 years) risks occurring.

Table 3: Consequence Table (Adapted from Alberta's DWSP Template)

Consequence	Definition	Value
Not applicable	Does not apply in this water system.	0
Insignificant	Wholesome water or interruption < 8 hours.	1
Minor	Short-term or localized non-compliance, not health related (e.g., aesthetic or interruption) 8 to 12 hours	2
Moderate	Widespread aesthetic issues or long-term non-compliance, not health related or interruption > 12 to 24 hours.	4
Severe	Potential illness or interruption > 24 to 48 hours	8
Catastrophic	Actual illness or potential long-term health effects or interruption.	16

Time frames for consequences may vary depending on population, watershed size, and other factors and must be considered. The risk-assessment score is calculated by multiplying the likelihood value by the impact value (i.e., Likelihood x Consequence = Risk Assessment Score). The risk matrix is calculated based on these scores and used to assess the risk that each threat poses to your drinking water source. These risks can be prioritized from highest risk (score of 256) to lowest risk (score of 0) as seen in Table 4, and management actions can be developed with your SWP committee. DWSPs are based on an extensive assessment of risk factors and are a valuable source of information.

Table 4: Risk Matrix (Adapted from Alberta's DWSP Template)

Likelihood Descriptor	Consequence Descriptor				
Score	**Insignificant**	**Minor**	**Moderate**	**Severe**	**Catastrophic**
Most unlikely	1	2	4	8	16
Unlikely	2	4	8	16	32
Medium	4	8	16	32	64
Probable	8	16	32	64	128
Almost certain	16	32	64	128	256

Table 5 is an example from the Camrose SWP plan of how the results of the risk assessment process may be summarized to assist with setting priorities and goals:

Table 5: Camrose's Urban Source Water Risks Assessment (Adapted from Camrose's SWP plan)

Urban Risks	Source	Description of Risk	Level of Risk
	Transportation	Roadway activities; sand and salt application and storage	High
		Snow storage and spring run-off	Moderate
	Stormwater	Run-off from urban environment	High
	Lawn care products	Use of lawn care products (e.g., fertilizers, pesticides, and herbicides)	High
	Development and construction	Development and construction activities	Moderate
	Green spaces and wetlands	Removal of upland vegetation	High
		Removal or degradation of riparian vegetation	Moderate
	Recreation and wildlife	Wildlife and pet activity	Low
	Wastewater	Pharmaceutical products, microbeads	Moderate

Other sources of information and factors to consider when assessing risks include the following:

- DWSP containing information about drinking water risks
- the GoA's database on water licences, registrations, and drinking water sources
- lake watershed management plans
- integrated watershed management plans
- regional plans, sub-regional land-use plans, and environmental management frameworks
- compliance with regulatory requirements based on local and provincial regulations and policies
- emergency preparedness and response plans for accidental spills or releases of contaminants or impacts from major weather events and natural disasters
- health, safety, and security planning to ensure the safety and security of employees, visitors, and facilities

Key Factors for Success

- ☐ Identify source water types used in your area (i.e., surface water and groundwater) as delineation methods may differ depending on the type.
- ☐ Consider the flow rate and direction of the water when delineating the source water area.
- ☐ Ensure you have all the information and data you need on land use as well as water quality and quantity—recognizing any gaps and how to address them ahead of time.
- ☐ Weigh the pros and cons of delineation methods before you begin the process. For example, some methods may be more expensive or time consuming than others, or better suited to a certain type of source water.

- ☐ Conduct statistically rigorous temporal trend analyses for water quality data parameters of significant concern as part of an early warning detection system.
- ☐ Identify the most important "hotspot" areas of the source water areas that pose the highest vulnerability or potential risk to drinking water systems.
- ☐ Inventory actual and potential future contaminant sources.
- ☐ Identify existing management, regulations, pollution control practices, limitations, and gaps.
- ☐ Apply risk-prioritization methods to score and rank risks based on likelihood and consequence.
- ☐ Periodically update data through monitoring, evaluation, synthesis, and communication.
- ☐ Seek technical expertise when delineating your source water area.
- ☐ Redefine your source water area if required to ensure that no risks are overlooked in the process (e.g., changes in political boundaries, new pipelines).
- ☐ Understand future changes in risks and have a timeframe to reassess these.
- ☐ Consider natural events and their unpredictability (e.g., floods, fires).
- ☐ Involve other key groups (e.g., other drinking water providers, water cooperatives, Indigenous communities) and the public when compiling a detailed inventory of your source water areas to identify environmental, social, and economic activities and potential contamination.

For more resources related to risk identification and management, see Section 3.

Stormwater Risks to Drinking Water Sources

The Alberta Urban Municipalities Association (AUMA) refers to stormwater as any water that flows over land and impervious surfaces during rainfall and snow melt events. Stormwater is filtered by natural vegetation and gradually seeps into soil. When vegetated areas are urbanized, changes in landscape properties and development contribute to increased run-off rates, larger stormwater volumes, and the accumulation of sediments. Impervious surfaces, such as parking lots and roads, prevent water from infiltrating through the soil. As this run-off flows across the land, water quality deteriorates as sediment, heavy metals, hydrocarbons, pesticides, and other pollutants accumulate. Increased run-off rates and pollutants in stormwater can also increase the risk of flooding, damage property and infrastructure, increase the frequency of sewer overflow events, degrade water quality, reduce available groundwater, compromise the health of aquatic habitats, decrease biodiversity, increase erosion and sedimentation rates, and disrupt water flow patterns. Proper stormwater management will help SWP efforts succeed. For more information, go to https://auma.ca/advocacy-services/programs-initiatives/water-management/watershed-management/stormwater

Step 3

SET GOALS

By setting goals you ensure that your source water area's unique challenges are addressed. After characterizing your source water area, assessing and ranking its risks, and reflecting on your vision, your goals can focus on SWP drivers and issues. With your SWP committee, try to craft SMART goals. SMART goals have the following characteristics:

- **Specific** — the goals clearly describe exactly what you want to achieve
- **Measurable** — the goals can be tracked and measured
- **Achievable** — the goals are realistic and attainable
- **Relevant** — the goals are aligned with your vision and priorities
- **Time-bound** — the goals have deadlines or time frames

Your goals should also meet the following criteria to ensure they are:

- prioritized to reflect risks of highest importance and areas where success is most likely.
- sorted into short, medium, and long term with linkages to DWSP risks and management actions where possible.
- relatively high level and broad based.
- nested within higher level goals (e.g., regional plans, watershed management plans, and municipal development plans).
- re-evaluated during the implementation of the SWP plan.
- updated or modified once they have been achieved or if priorities shift.

> "The voices in the water may be subdued and elusive, but we would do well to try and hear what they have to say."
>
> *Kevin Van Tighem, Author of Heart Waters, Sources of the Bow River*

For the goals to be implemented successfully, internal and external groups should be involved in developing them since many of the goals will require their input and support. For example, the overarching goal of Camrose's SWP Plan is to support the protection and improvement of surface water quality in the Battle River and Driedmeat Lake, which are critical water sources for the City of Camrose and many county residents. The draft Grimshaw Gravels Aquifer Source Water Protection Plan's goal is to identify potential contaminant hazards to the aquifer, assess the associated risks, and develop management actions to reduce these risks. The goals of the City of Calgary's SWP Plan are described in Case Study 3.

Case Study 3: The Goals of the City of Calgary's SWP Plan

The City of Calgary is committed to delivering high quality, safe drinking water to over 1.3 million citizens. Its plan was developed between 2015 and 2018 and based on provincial direction and guidance, water quality monitoring data, technical risk assessments, internal and external engagement, and best practice guidelines and standards. The goals of the SWP plan are as follows:

- protect the source watershed with improved land-use planning
- promote innovation in stormwater management to protect source water quality
- leverage key partnerships for risk mitigation
- involve the community through education and research

For more resources related to goal setting, see Section 3.

Key Factors for Success

- ☐ Link goals to the overarching vision, key risks, and action plan for your source water area.
- ☐ Ensure that goals are specific, measurable, achievable, relevant, and time-bound (i.e., SMART goals).
- ☐ Prioritize goals into short, medium, and long-term categories to help allocate resources and time efficiently.
- ☐ Ensure strategies are science informed.
- ☐ Use risk-assessment results to inform and prioritize goals.
- ☐ Ensure goals address future land use and land-use changes.
- ☐ Make sure that goals meet or exceed regulatory requirements.
- ☐ Implement a process for periodic revision and improvement of goals and methods to measure progress against the goals as part of an adaptive management feedback loop.

Step 4

DEVELOP AN ACTION PLAN

"When we are born, it is water that comes first. Birth is sacred and so is the water."

George Brertton, Cree Elder, Saddle Lake First Nation

After your SWP committee has established a vision, characterized the source water area, and developed supporting goals, the next step is to develop an action plan to help your SWP committee turn its vision and goals into reality. This plan will serve as a roadmap to prevent or mitigate risks to your drinking water source while offering opportunities for ongoing public participation.

The action plan should be well-connected to your SWP goals and specific enough to cover details so that key groups and more, importantly, the people who will implement it are engaged. For example, the goal of the City of Calgary's SWP plan to improve land-use planning is supported by specific actions to develop recreational strategies and drinking water protection zones in collaboration with key stakeholders within specific timelines. Depending on your source water area's characterization and how its risks were prioritized, you should tackle higher-ranked risks first. Table 6 provides an example of some of Camrose's recommended SWP management actions as an example.

The following checklist can be used to guide the development of your action plan:

- **What** — Brainstorm the management actions to include in the plan.
- **Who** — Assign a responsible person or group for each management action.
- **When** — Determine a timeline for completing each management action.
- **Allocate** — Ensure that there are enough resources for accomplishing each management action including the budget.
- **Engage and communicate** — Provide opportunities for public participation with other key groups, individuals, and the public. As noted in Section 1, the IAP2 outlines five steps that can be followed when developing an engagement plan.
- **Revise and improve** — Set a timeline to review and update your action plan based on the input obtained and lessons learned during implementation.
- **Integrate** — Ensure that your management actions and overarching SWP plan align with existing drinking water protection initiatives and other related work (e.g., integrated watershed management plans, DWSP, regional land-use plans, and municipal development plans).

Table 6: Camrose's Recommended Management Actions (Adapted from Camrose's SWP plan)

	Management Action	Responsibility	Timeline
High Risk	Oil and Gas Development It is recommended that Camrose County and the Alberta Energy Regulator develop a Watershed Development Plan to guide oil and gas development in the Driedmeat Lake watershed. A similar plan has been developed for the Battle Lake watershed.	– Camrose County – Alberta Energy Regulator	Medium-term
Moderate Risk	Development and Construction It is recommended that the City of Camrose and Camrose County require developers to develop erosion and sediment control plans for new and infill development.	– City of Camrose – Camrose County – Developers	Short-term
Low Risk	Recreation It is recommended that the City of Camrose continue to maintain and expand the use of bag dispensers and garbage bins along walking trails and encourage recreationists to keep trails and green spaces clean of waste.	– City of Camrose	Short-term

- **Evaluate** –Ensure that you have a mechanism for evaluating how actions are being implemented and by whom.
- **Contingency measures** –Consider future risks and how they may influence implementing this action plan.
- **Draft outline for your SWP plan**
  - introduction — background and characteristics of the source water area, importance of management, why the committee was established, its terms of reference, and other information

- water quality and quantity issues — breakdown of the activities and potential contaminants in your source water area, associated risks and their prioritization, and overview of the main challenges
- goals and objectives — intent of the SWP plan
- management actions — detailed options for addressing risks to the source water and contingency measures
- implementation plan — engagement plan for involving key groups and the public, developing a schedule with timelines and resource allocation, and creating measures to evaluate and revise the SWP plan at periodic intervals

For ideas on how to create your action plan, refer to the GoA's *Guide to Watershed Management Planning in Alberta* and the *Alberta Lake Management Society's Workbook for Developing Lake Watershed Management Plans in Alberta*.

Key Factors for Success

- ☐ Make your action plan as specific as possible to your source water area (i.e., the plan should be based on your source water types and the activities around them).
- ☐ Leverage partners, momentum, and capacity across organizations to maximize success.
- ☐ Include contingency measures for addressing emergencies in the source water area.
- ☐ Treat the action plan as a living document that will change as it is implemented and evaluated over time.
- ☐ Provide opportunities to engage key groups and the public in developing the action plan at key milestones.
- ☐ Prioritize timelines for short-, medium-, and long-term actions. Develop the budget, scope, roles and responsibilities, and schedules for each action, using project management principles and best practices.
- ☐ Address highly sensitive and vulnerable areas in the action plan.
- ☐ Acknowledge conflicts and tradeoffs, including political feasibilities before finalizing the plan.
- ☐ Ensure that a response plan for spills and other incidents is in place.
- ☐ Establish a designated project manager position.
- ☐ Measure and report on success.

For more resources related to developing an action plan, see Section 3.

Step 5

IMPLEMENT THE ACTION PLAN

A clear approach for implementing your management actions is vital to successfully protecting sources of drinking water. These management actions must be implemented on time and with enough resources to realize your SWP goals and overarching vision. An implementation strategy ensures that unexpected challenges and opportunities are addressed throughout the plan's lifecycle and that progress can be measured periodically. Clearly defined and allocated funds and resources can lead to more effective implementation.

Working with your SWP group, the following steps help as you develop your implementation strategy:

- **Define your approach** — Determine how your SWP group will implement the action plan by prioritizing management actions from high to low risk, and short- and long-term objectives. This approach helps determine which actions are more likely to have early success, thereby building momentum for implementation.
- **Build it** — Create an implementation schedule with associated timelines and budgets for each management action.
- **Establish checkpoints** — Determine how often your SWP group should meet to discuss the action plan's progress, challenges, and opportunities.
- **Set up reporting methods** — Choose a consistent method of reporting the implementation progress of the action plan (e.g., monthly meetings, email updates, and interim reports).
- **Link implementation to evaluating and revising your SWP plan** — Ensure that any actions taken are part of your reporting methods and are linked to the action plan's evaluation and reporting process.

Key Factors for Success

- ☐ Have a clearly defined schedule that demonstrates timelines, how resources are allocated, and who is responsible for specific activities.
- ☐ Ensure that implementation of the action plan is tied into its evaluation (see Step 6).
- ☐ Seek partnerships to support implementing and expanding SWP efforts (e.g., public, private, and individual drinking water providers can collaborate by sharing costs and expertise).
- ☐ Identify capacity gaps and have a plan to address them ahead of time (e.g., financial, social, institutional, human resources, technical challenges).
- ☐ Link the SWP plan to other drinking water provider priorities (e.g., drinking water safety plans, municipal development plans, stormwater management plans, intermunicipal development plans).
- ☐ Celebrate successes no matter how small.
- ☐ Keep track of milestones.

For more resources related to action plan implementation, see Section 3.

Resources for Supporting Source Water Protection Work

Several programs exist to help with SWP efforts, including the following:

- Alberta Municipal Water/Wastewater Partnership — Municipalities can apply for funding for municipal water supply and treatment facilities, and wastewater treatment and disposal facilities.
- Alberta Community Resilience Program — A multi-year grant supporting the development of long-term resilience to flood and drought events, while supporting integrated planning and healthy functioning watersheds.
- Alberta Community Partnership — This program helps improve the viability and long-term sustainability of municipalities by providing support for regional collaboration and capacity- building activities.
- Municipal Sustainability Initiative — This initiative provides municipalities with sustainable funding to assist them in meeting the challenges of growth and enhancing their long-term sustainability.
- Rural and Northern Communities Infrastructure — Eligible communities with populations of 100,000 or less can apply for funding to support projects that improve infrastructure in small, rural, and remote communities.
- Social Sciences and Humanities Research Council (SSHRC) — A federal research-funding agency that promotes and supports post-secondary research and training in the humanities and social sciences.
- ALUS Canada — The ALUS program is a community-led, farmer-delivered program that supports stewardship activities on agricultural lands.

Case Study 4: First Nations Technical Services Advisory Group Inc. Community-Led Source Water Protection Planning

Since 2013, First Nations Technical Services Advisory Group Inc. (TSAG) has successfully supported the development of more than 10 SWP plans with First Nations in Alberta. It has become apparent that First Nations are very interested in how other First Nations are engaging in SWP planning processes, from the inclusion of traditional knowledge, to the support of plan implementation. With funding from the Social Sciences and Humanities Research Council, the project brought together nine First Nations from Alberta and Saskatchewan who have developed SWP plans. The workshop, delivered in collaboration with Dr. Robert Patrick from the University of Saskatchewan, created an opportunity for information sharing and the mobilization of knowledge. Following the two-day workshop, TSAG developed a position paper highlighting the successes, challenges, and next steps for First Nations creating and implementing SWP plans. The paper was presented at the Connections Forum in March 2019. For more information, go to http://www.tsag.net/

Step 6

EVALUATE AND REVISE PERIODICALLY

For any SWP plan to succeed, it should be evaluated and revised periodically to ensure that the vision and goals remain relevant and are being accomplished. SWP is a long-term process, and any plan should be treated as a living document open to changes and flexible when necessary. Most plans place more emphasis on planning and less focus on evaluating performance and revising approaches. An evaluation and review process involve collecting and analyzing information about a SWP program's activities, characteristics, and outcomes, and adjusting to ensure that the plan is flexible to changes in its environmental, social, and economic landscape. The purpose of an evaluation and review process is to enable informed decisions to improve the effectiveness. According to My Environmental Education Evaluation Resource Assistant (MEERA), evaluating and revising your SWP plan can:

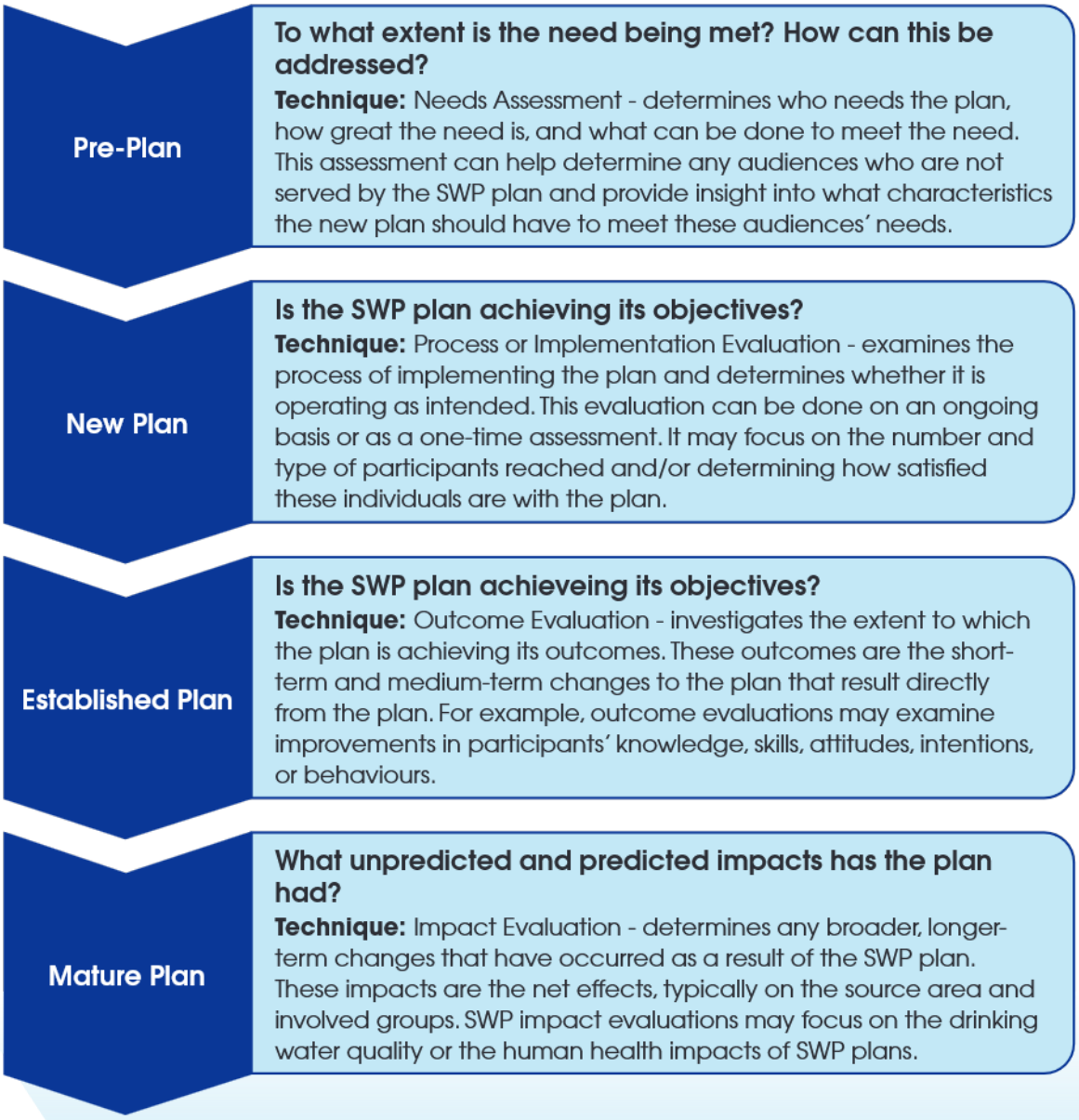
- **Improve plan design and implementation** — It is important to periodically assess and adapt your activities to ensure that they are as effective as possible. Evaluation can help you identify areas for improvement and ultimately help you realize your goals more efficiently.
- **Demonstrate plan impact** — Evaluation enables you to demonstrate your success or progress. The information you collect allows you to better communicate your plan's impact to others, which is critical for public relations, staff morale, and attracting and retaining support from current and potential funders.

Monitoring the effectiveness of actions taken generates information that can be used to modify your vision, goals, source water area's characterization, action plan, and implementation strategy. This exercise will ensure that your SWP plan can respond to changes in the source water area, contaminants and other types of risks, and it will also help assess the performance of your action plan and its management activities. The type of evaluation and review will depend on the status of your SWP program as seen in Case Study 5. For example, some evaluations are undertaken early in a plan's development and implementation for guidance on how to better achieve goals and improve the plan; these are referred to as formative evaluations. Summative evaluations are conducted when a plan is more established to determine how well it is achieving its goals. Figure 3 illustrates evaluation types and purposes.

The following steps can help with evaluating and revising your SWP plan:

- **Engage key groups and the public** — As supporters and implementers of your plan, these groups need to be involved in evaluating its effectiveness.
- **Describe the program** — Explain what your plan is trying to achieve and how it intends to make changes happen.
- **Tailor your evaluation to specific needs** — Determine what you would like to focus the exercise on (e.g., producing set deliverables, using allocated resources wisely, and adhering to an agreed-upon process).
- **Gather information** — You will need qualitative and quantitative evidence. Qualitative evidence is descriptive and demonstrates changes in values, opinions, attitudes, and knowledge. It is collected through interviews, focus groups, observation, and other methods. Quantitative evidence is information about quantities (numbers) and helps draw general conclusions and changes in trends over time. It is collected through surveys, questionnaires, and other methods.
- **Develop themes** — From the information gathered, consider whether the plan is getting better or worse, or not changing or static. Compare goals and other set targets to determine any progress made.
- **Share findings** — Be sure to document and communicate your findings with key groups and the public. Many groups create a "lessons learned" document.
- **Review and incorporate changes** — Work with your committee to determine if existing goals and management actions still reflect current needs and issues and where changes should be made to the existing SWP program. Agree upon a time to review your plan; most plans are evaluated and reviewed every three to five years.

Figure 2: Evaluations Types, Stages, and Purposes (Adapted from MEERA, 2018)



Case Study 5: Implementation Summary Report: Bow River Phosphorus Management Plan

The increasing nutrient levels in the Bow River downstream of Calgary have long been a concern. In 2011, AEP invited stakeholders in the affected reach of the Bow River to initiate a voluntary, collaborative process to address phosphorus loadings from point and non-point sources. The Bow River Phosphorus Management Plan (PMP) has a PMP Implementation Committee that evaluates progress over time in a simple and concise way. The status of actions is reported as "in progress," "sustainable progress," or "completed" in their implementation summary report using pie charts. For more information, go to https://open.alberta.ca/publications/bow-river-phosphorus-management-plan-2017-implementation-summary-report.

Key Factors for Success

- ☐ Ensure that evaluation methods are built into your SWP plan from the beginning. Don't wait until the end to track progress.
- ☐ Document and communicate lessons learned with key groups and the public.
- ☐ Weigh the pros and cons of evaluation methods before selecting and implementing one; some methods are better suited for certain activities.
- ☐ Have a mechanism in place to review your SWP plan every three to five years to mark areas of success and improvement. Engage key groups and the public in this review.
- ☐ Re-evaluate potential risks using new data and information.
- ☐ Undertake periodic environmental scans to update evaluation and revision practices.

For more resources related to evaluating and revising a SWP plan, see Section 3

2.0 Summary

Source water protection requires a well-coordinated and collaborative approach among public, private, and individual drinking water providers and other partners in a source water area. This approach will ensure the effective development, implementation, and evaluation of plans to mitigate potential risks to drinking water quality and quantity. SWP should be viewed as an ongoing and long-term process in which plans are evaluated regularly to ensure that the appropriate groups are at the table addressing emerging challenges and sharing and using new tools, technology, and information.

In Alberta, drinking water providers have developed DWSPs for their drinking water systems, but SWP is a broader and more collaborative and integrated approach for protecting drinking water sources. A designated lead can help facilitate this process and also financial assistance, technical and personnel resources, and centralized tools also encourage SWP planning.

Integrating SWP plans with other types of land and water initiatives remains a challenge in Alberta. Although planning, collaboration, and ongoing evaluation are common to most SWP plans, each source water area is unique and requires adapting its SWP planning approach to local risks, conditions, challenges, and opportunities.

3.0 Resources and Tools

Step 1: Involve Key Groups and Create a Vision

Battle River Watershed Alliance, 2014. *Terms of Reference for the Camrose Source Water Protection Initiative*. Available online: https://camrosecounty.civicweb.net/document/59391/Camrose%20SWP%20Initiative%20Terms%20of%20Reference.pdf

Clean Air Strategic Alliance, 2010. *Consensus Decision-making Toolkit*. Available online: https://www.casahome.org/uploads/source/PDF/CDM-toolkit-web.pdf

Community Toolbox, 2018. *Developing and Communicating a Vision*. Available online: https://ctb.ku.edu/en/table-of-contents/leadership/leadership-functions/develop-and-communicate-vision/main

Government of Alberta, 2003. *Enabling Partnerships: A Framework in Support of Water for Life: Alberta's Strategy for Sustainability*. Available online: https://open.alberta.ca/publications/0778542424

Government of Nova Scotia, 2009. *Developing a Municipal Source Water Protection Plan: A Guide for Water Utilities and Municipalities: Step 1 Form a Source Water Protection Advisory Committee*. Available online: https://novascotia.ca/nse/water/docs/WaterProtectionPlanStep1.pdf

Lake Erie Region Source Protection Committee, 2009. *Grand River Protection Area: Approved Terms of Reference*. Available online: https://www.sourcewater.ca/en/source-protection-areas/resources/Documents/Grand/Grand_Reports_TermsOfReference.pdf

Land Stewardship Centre, 2014. *The Stewardship Toolbox*. Available online: http://www.landstewardship.org/media/uploads/141222-LSC_Toolbox_web_final.pdf

Water Research Foundation, 2012. *Source Water Protection Vision and Roadmap*. Available online: https://aquadoc.typepad.com/files/4176b_swp_vision_roadmap.pdf

Step 2: Characterize Your Source Water Area

Alberta Energy Regulator, 2011. *Edmonton-Calgary Corridor Groundwater Atlas*. Available online: https://ags.aer.ca/publications/INF_140.html

Alberta Lake Management Society, 2018. *Lake Watershed Management Plans*. Available online: https://alms.ca/completed-lake-watershed-plans/

Altalis, 2018. Altalis. Available online: https://beta.altalis.com/

CGE Risk Management Solutions, 2018. *The Bowtie Method*. Available online: https://www.cgerisk.com/knowledgebase/The_bowtie_method

Environmental Protection Agency, 2017. *Conducting Source Water Assessments*. Available online: https://www.epa.gov/sourcewaterprotection/conducting-source-water-assessments

Government of Alberta, 2018. *Alberta Environment's Drinking Water Program*. Available online: http://environment.alberta.ca/apps/regulateddwq/More.aspx

Government of Alberta, 2019. *Environmental Site Assessment Repository*. Available online: https://www.alberta.ca/environmental-site-assessment-repository.aspx

Government of Alberta, 2018. *Alberta Rivers App*. Available online: https://itunes.apple.com/ca/app/alberta-rivers/id888325071?mt=8

Government of Alberta, 2015. *Alberta River Water Quality Index*. Available online: http://aehttps://open.alberta.ca/opendata/river-water-quality-index-albertap.alberta.ca/water/reports-data/alberta-river-water-quality-index.aspx

Government of Alberta, 2018. *Alberta Water Well Information Database*. Available online: http://groundwater.alberta.ca/WaterWells/d/

Government of Alberta, 2018. GeoDiscover Alberta. Available online: https://geodiscover.alberta.ca/geoportal/#searchPanel

Government of Alberta, 2015. *Groundwater Observation Well Network*. Available online: https://www.alberta.ca/groundwater-observation-well-network.aspx

Government of Alberta, 2019. *Flood Hazard Mapping Application*. Available online: http://maps.srd.alberta.ca/FloodHazard/

Government of Alberta, 2019. *Soil Information Viewer*. Available online: https://soil.agric.gov.ab.ca/agrasidviewer/

Government of Nova Scotia, 2009. *Developing a Municipal Source Water Protection Plan: A Guide for Water Utilities and Municipalities: Step 2 Delineate a Source Water Protection Area Boundary*. Available online: https://novascotia.ca/nse/water/docs/WaterProtectionPlanStep2.pdf

Government of Nova Scotia, 2009. *Developing a Municipal Source Water Protection Plan: A Guide for Water Utilities and Municipalities: Step 3 Identify Contaminants and Assess Risk*. Available online: https://novascotia.ca/nse/water/docs/WaterProtectionPlanStep3.pdf

Government of Alberta, 2018. *Rural Water Quality Information Tool*. Available online: https://www.agric.gov.ab.ca/app84/rwqit

Government of British Columbia, 2017. *Guidance Document for Determining Groundwater at Risk of Containing Pathogens*. Available online: 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

Water Security Agency and Saskatchewan Ministry of Environment, 2012. *Groundwater Under the Direct Influence of Surface Water Assessment Guideline*. Available online: http://www.saskh2o.ca/DWBinder/epb284.pdf.

Step 3: Set Program Goals

Community Toolbox, 2018. *Creating Objectives*. Available online: https://ctb.ku.edu/en/table-of-contents/structure/strategic-planning/create-objectives/main

North Carolina Watershed Stewardship Network, 2018. *Writing SMART, Short-term Outcome Objectives*. Available online: http://ncwatershednetwork.org/wp-content/uploads/2016/05/Writing-SMART-short-term-outcomes-and-objectives.pdf

University of California, 2017. *SMART Goals: A How to Guide*. Available online: https://www.ucop.edu/local-human-resources/_files/performance-appraisal/How%20to%20write%20SMART%20Goals%20v2.pdf

Step 4: Develop an Action Plan

Community Toolbox, 2018. *Developing an Action Plan*. Available online: https://ctb.ku.edu/en/table-of-contents/structure/strategic-planning/develop-action-plans/main

Community Toolbox, 2018. *Involving People Most Affected by the Problem*. Available online: https://ctb.ku.edu/en/table-of-contents/participation/encouraging-involvement/involve-those-affected/main

International Association for Public Participation, 2006. *Planning for Effective Public Participation.*

Step 5: Implement the Action Plan

Battle River Watershed Alliance, 2014. *Source Water Protection: Implementation Guidelines*. Available online: http://www.battleriverwatershed.ca/wp-content/uploads/2018/08/BRWA-Source-Water-Protection-Implementation-Guidelines-Report.pdf

Step 6: Evaluate and Revise Periodically

Community Toolbox, 2018. *A Framework for Program Evaluation: A Gateway to Tools.* Available online: https://ctb.ku.edu/en/table-of-contents/evaluate/evaluation/framework-for-evaluation/main

Free Management Library, 2019. *Basic Guide to Program Evaluation.* Available online: https://managementhelp.org/evaluation/program-evaluation-guide.htm

Government of Nova Scotia, 2009. *Developing a Municipal Source Water Protection Plan: A Guide for Water Utilities and Municipalities: Step 5 Develop a Monitoring Program to Evaluate the Effectiveness of a Source Water Protection Plan*. Available online: https://novascotia.ca/nse/water/docs/WaterProtectionPlanStep5.pdf

My Environmental Education Evaluation Resource Assistant, 2018. *Evaluation: What is it and why do it?* Available online: http://meera.snre.umich.edu/evaluation-what-it-and-why-do-it

Examples of Source Water Protection Plans in Alberta

City of Calgary, 2018. *Source Water Protection Plan: Protecting our source watershed through proactive collaboration.* Available online: http://www.calgary.ca/UEP/Water/Documents/Water-Documents/Source-Water-Protection-Plan.pdf

City of Camrose and Camrose County, 2016. *Camrose Source Water Protection Plan*. Available online: https://camrosecounty.civicweb.net/filepro/document/73748/Camrose%20Source%20Water%20Protection%20Plan%20FINAL%20DRAFT%20Sept%202016.pdf

EPCOR Utilities Inc., 207. *2017 Source Water Protection Plan: Edmonton's Drinking Water System*. Available online: https://www.epcor.com/products-services/water/Documents/source-water-protection-plan.pdf

First Nations Technical Services Advisory Group Inc., 2017. *Wabasca Area Source Water Protection Plan*. Available online: http://www.mdopportunity.ab.ca/sites/default/files/u808/20170404%20Wabasca%20Area%20SWPP.pdf

Town of Grande Cache, 205. *Source Water Protection Plan: Victor Lake and Grande Cache Lake*. Available online: https://grandecache.civicweb.net/document/3344

Other Useful Source Water Protection Documents

Alberta Federation of Rural Water Co-operatives Ltd., 2014. *Best Practices Manual for Rural Water Co-ops*.

Battle River Watershed Alliance, 2014. *Source Water Protection: Policy Advice*. Available online: http://www.battleriverwatershed.ca/wp-content/uploads/2018/08/BRWA-Source-Water-Protection-Policy-Advice-Report.pdf

Battle River Watershed Alliance, 2018. *Source Water Protection Background Research Report*. Available online: http://www.battleriverwatershed.ca/wp-content/uploads/2018/08/BRWA-Source-Water-Protection-Policy-Context-Report.pdf

Alberta Lake Management Society, 2013. *Workbook for Developing Lake Watershed Management Plans in Alberta*. Available online: https://hardisty.civicweb.net/document/14720

American Water Works Association, 2017. *Source Water Protection Operation Guide to AWWA Standard G300*. Available online: https://www.awwa.org/store/productdetail.aspx?productid=64049372

American Water Works Association, 2018. *Source Water Protection Justification Toolkit*. Available online: https://www.awwa.org/LinkClick.aspx?fileticket=XHjsy8Uosj8%3d&portalid=0

Canadian Council of Ministers of the Environment, 2004. *From Source to Tap: Guidance on the Multi-Barrier Approach to Safe Drinking Water*. Available online: https://www.ccme.ca/files/Resources/water/source_tap/mba_guidance_doc_e.pdf

Clean Water Network, 2003. *Source Water Stewardship: A Guide to Protecting and Restoring your Drinking Water*. Available online: http://www.cleanwateraction.org/files/publications/national/sourcewater-stewardship-guide.pdf

Government of Alberta, 2018. *A Primer on Water Quality*. Available online: https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/wat3345

Government of Alberta, 2017. *Alberta Environment's Drinking Water Program: A Source to Tap, Multi-barrier Approach*. Available online: https://open.alberta.ca/dataset/alberta-environment-s-drinking-water-program-a-source-to-tap-multi-barrier-approach/resource/f80a66d9-0bbe-4b7d-ac8b-192335de278f

Government of Alberta, 2013. *Guide to Watershed Planning in Alberta*. Available online: https://open.alberta.ca/dataset/9781460118535/resource/97053643-777e-407e-800c-79e2a5975dfd

Government of Alberta, 2015. *Draft Guide to Source Water Protection Planning in the South Saskatchewan Region.* Available online: http://www.rdrwa.ca/sites/rdrwa.ca/files/pdf/Guide%20to%20Source%20Water%20Protection%20Planning%20in%20SSR%20DRAFT%20v3.pdf

Government of British Columbia, 2010. *Comprehensive Drinking Water Source-to-Tap Assessment Guideline*. Available online: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/drinking-water-quality/resources-for-water-system-operators#source-to-tap-assessment

Government of British Columbia, 2004. *Drinking Water Source-to-Tap Screening Tool*. Available online: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/documents/bc_drinking_water_screening_tool.pdf

Government of Canada, 2018. *First Nations On-Reserve Source Water Protection Plan.* Available online: https://www.aadnc-aandc.gc.ca/eng/1398369474357/1398369572276#chp10

Pollution Probe, 2014. *The Source Water Protection Primer*. Available online: http://www.pollutionprobe.org/publications/the-source-water-protection-primer/

Red Deer River Municipal Users Group, 2017. *A Toolkit for Protecting Source Water Quality in the Red Deer River Watershed.* Available online: http://rdrmug.ca/wp-content/uploads/2014/11/Final-3rd-printing-Toolkit-Report.pdf

Red Deer River Municipal Users Group, 2016. *Source Water Quality Primer.* Available online: http://rdrmug.ca/wp-content/uploads/2016/03/Source-Water-Quality-Primer-1.pdf

Source Water Collaborative, 2018. *Collaboration Toolkit: Protecting Drinking Water Sources Through Agricultural Conservation Practices.* Available online: https://sourcewatercollaborative.org/swp-usda/

Related Legislation and Policies

Government of Alberta, 2009. *Alberta Land Stewardship Act.* Available online: http://www.qp.alberta.ca/documents/Acts/A26P8.pdf

Government of Alberta, 2017. *Agricultural Operation Practices Acts and Regulations.* Available online: https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/acts5986

Government of Alberta, 2017. *Environmental Protection and Enhancement Act.* Available online: http://www.qp.alberta.ca/documents/Acts/E12.pdf

Government of Alberta, 2014. *Forests Act.* Available online: http://www.qp.alberta.ca/documents/Acts/F22.pdf

Government of Alberta, 2018. *Municipal Government Act*. Available online: http://www.qp.alberta.ca/documents/Acts/m26.pdf

Government of Alberta, 2014. *Our Water, Our Future: A Plan for Action*. Available online: https://open.alberta.ca/publications/9781460118900

Government of Alberta, 2017. *Public Health Act.* Available online: http://www.qp.alberta.ca/documents/Acts/P37.pdf

Government of Alberta, 2014. *Public Lands Act*. Available online: http://www.qp.alberta.ca/documents/Acts/P40.pdf

Government of Alberta, 2018. *Regional Plans*. Available online: https://landuse.alberta.ca/REGIONALPLANS/Pages/default.aspx

Government of Alberta, 2012. *Taking Care of Your Drinking Water and Wastewater: A Guide for Member of Municipal Councils*. Available online: http://www.westendregionalsewageservicescommission.ca/uploads/5/8/1/2/5812407/3_wastewater_guide.pdf

Government of Alberta, 2017. *Water Act.* Available online: http://www.qp.alberta.ca/documents/Acts/w03.pdf

Government of Alberta, 2003. *Water for Life: Alberta's strategy for sustainability*. Available online: https://open.alberta.ca/publications/0778530582

Government of Alberta, 2018. *Working Well Program.* Available online: https://www.alberta.ca/working-well.aspx

Government of Canada, 2018. *Pulp and Paper Effluent Regulations*. Available online: http://laws-lois.justice.gc.ca/eng/regulations/SOR-92-269/

Related Groups and Organizations

Alberta Environment and Parks https://www.alberta.ca/environment-and-parks.aspx

Alberta Federation of Rural Water Co-operatives Ltd. https://abwaterco-op.com/index.php

Alberta Health http://www.health.alberta.ca/

Alberta Lake Management Society https://alms.ca/

Alberta Low Impact Development Partnership https://alidp.org

Alberta Urban Municipalities Association https://auma.ca/

Alberta Water Council https://www.awchome.ca/

American Water Works Association https://www.awwa.org/

Cows and Fish https://cowsandfish.org

First Nations Technical Services Advisory Group Inc. http://www.tsag.net/

Land Stewardship Centre http://www.landstewardship.org/

Red Deer River Municipal Users Group http://rdrmug.ca/

Rural Municipalities of Alberta https://rmalberta.com/

Watershed Planning and Advisory Councils https://www.alberta.ca/watershed-planning-and-advisory-councils.aspx

4.0 Legislation and Policies Related to Source Water Protection in Alberta

Environmental Protection and Enhancement Act (EPEA)

The *Environmental Protection and Enhancement Act* prohibits the release of any substance into the environment that might cause a significant adverse environmental effect. EPEA provides direction for the management of wastewater systems, contaminated sites, storage tanks, landfills, and hazardous waste. For example, municipalities and industries have limits in their EPEA approvals for the treatment and release of effluent into waterbodies. Approved drinking water systems require an approval under the EPEA and are referred to as waterworks systems. Public waterworks systems that require health related treatment of their raw water before distribution serve approximately 80 per cent of the population in Alberta. Waterworks systems that do not require an approval under EPEA are governed by Alberta Health and Alberta Health Services.

Water Act

The *Water Act* focuses on the planning, use, and enforcement needed to manage and protect Alberta's water. It emphasizes the wise use and allocation of water, including the protection of rivers, streams, lakes, and wetlands. The *Water Act* governs water diversion, allocation, and usage of water in Alberta, and an approval or licence is required before a construction activity can be undertaken in a water body or before diverting and using water. Under the Water (Ministerial) Regulation and *Water Act* Codes of Practice, activities related to watercourse crossings for roads, pipelines, and transmission lines are regulated. A water conservation objective (WCO) is an instrument used under section 15 of the *Water Act* to define the quantity and quality of water to remain in a river or other body of water. A WCO can be used for the protection of a water body, the aquatic environment, tourism, recreational, transportation, waste assimilation uses of water, or the management of fish or wildlife.

Public Health Act (PHA)

The *Public Health Act* contains broad provisions to address health issues pertaining to any condition that may negatively impact public health including conditions that may give rise to unsafe drinking water. Under the PHA, the Nuisance and General Sanitation Regulation outlines various requirements associated with domestic water and sewage systems that are outside the scope of the EPEA. Once treated water moves out of the waterworks distribution system past the service connection for a residence, Municipal Affairs governs under the *Safety Codes Act*, including the Plumbing Code Regulation. This prevents or controls pollutants from the materials used to build the service connection contaminating the treated water. .

Alberta Land Stewardship Act

Regional land-use planning is governed by the *Alberta Land Stewardship Act*. It requires decision making on land-use activities by municipalities and local government bodies to review their regulatory instruments, and then make any necessary changes to ensure these instruments comply with the regional plan.

Municipal Government Act

The *Municipal Government Act* (MGA) provides the legislative framework and governance model for cities, towns, villages, municipal districts, specialized municipalities, and other forms of local government. It lays the foundation for how municipalities operate, how municipal councils' function, and how citizens can work with their municipalities. Every municipality is required to have land-use bylaws, and municipalities with more than 3,500 residents must adopt a Municipal Development Plan. Both the bylaws and the Municipal Development Plan have a strong influence on land-management decisions that affect the protection of water sources. For example, municipalities have the authority to regulate management of private land to control non-point source pollution, including development conditions and setbacks from water bodies (MGA, Sections 640 and 644).

Intermunicipal Development Plans

These plans are approved by Council in between two municipalities. Planners refer to these documents to make recommendations to Council for managing or changing land use, and to address growth issues in a way that respects the interests of the county and the municipalities they share a border with. Recent *Municipal Government Act* amendments introduced mandatory arrangements: growth management boards for the Edmonton and Calgary regions and mandatory intermunicipal collaboration frameworks that include intermunicipal development plans for all municipalities that are not members of regional growth management boards. These plans may include the following:

- how the two municipalities will work together
- development of joint lands
- how to co-ordinate parks, open space, recreation, transportation, water, services, and utilities across boundaries

Private Sewage Disposal Systems Regulation

The *Private Sewage Disposal Systems Regulation* adopts the 2009 Alberta Private Sewage Systems Standard of Practice. The private sewage standards set out design, installation, and material requirements for on-site private sewage systems serving a single property or handling less than 25 cubic metres (5,500 Imperial gallons) of sewage volume per day.

Public Lands Act

The Crown owns the bed and shores of a water body under the *Public Lands Act*. Approvals are required for any activity that involves the alteration or occupation of Crown-owned land.

Agricultural Operation Practices Act (AOPA) and regulations

The *Agricultural Operation Practices Act* and regulations include manure management requirements for all livestock operations in Alberta. The AOPA includes setbacks required from water bodies when locating livestock operations and applying manure to land.

Other Legislation, Policies, and Programs Relevant to Source Water Protection

Alberta Environment's Drinking Water Program: A 'Source to Tap, Multi-Barrier' Approach, released in 2009, outlines the province's multi-barrier approach, which consists of legislation, drinking water systems, knowledge and awareness, performance assurance, and protection including proactive and preventive measures and emergency response. Several other policies and legislation in Alberta minimize the effect that land-use activities have on water quality. For example, public land can be managed to reduce impacts on water quality through the *Provincial Parks Act* and the *Wilderness Areas, Ecological Reserves and Natural Areas Act*. The *Forests Act* aids in the management of non-point source impacts from forestry practices through the approval of Forest Management Plans and Annual Operating Plans.

Notes

Notes

Photo Credits

Page 7 Anuja Ramgoolam

Page 13 Gregg Tye

Page 26 Anuja Ramgoolam

Page 29 Anuja Ramgoolam

Page 35 Jay White

Page 39 EPCOR Utilities

www.awchome.ca