

SASKATCHEWAN'S LAKE STEWARDSHIP STRATEGY

This project was undertaken with the financial support of
Ce projet a été réalisé avec l'appui financier de



Canada
Water Agency

Agence de l'eau
du Canada

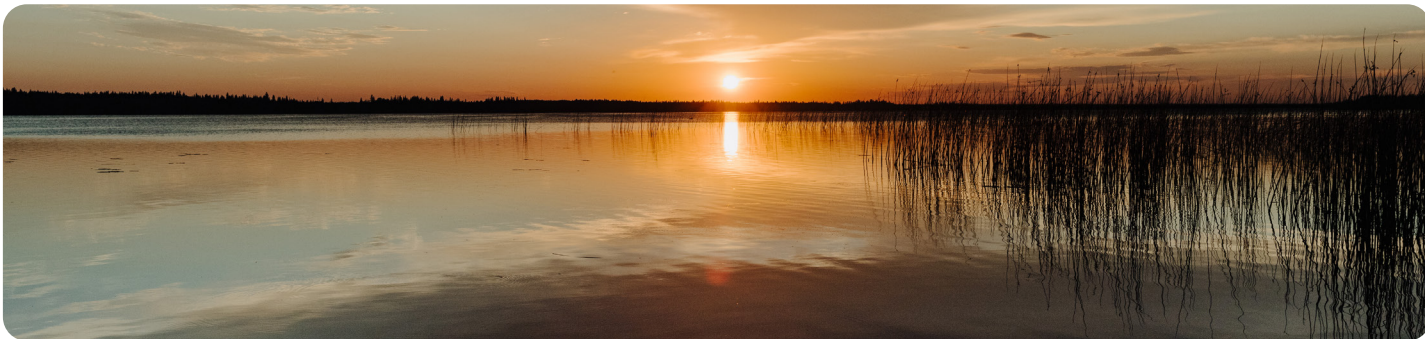


SAW

Saskatchewan
Association
of Watersheds

TABLE OF CONTENTS

1.0 Executive Summary	3
2.0 Introduction	3
3.0 Background	4
4.0 Legislation Protecting Saskatchewan Lakes	5
5.0 Water Quality	5
5.1 Eutrophication	6
5.11 Agricultural or Converted Land	6
5.12 Wastewater	7
5.2 Sedimentation and Erosion	8
5.21 Lakefront Development	9
5.22 Watercraft	9
5.3 Chemical or Bacterial Contamination	9
5.31 Large-Scale Spills	10
5.32 Lake Property Owner Spills and Chemical, Pesticide, or Herbicide Use	10
5.33 Sewage or Septic Tank Leakage	11
5.4 Water Quality Monitoring for Communities	11
6.0 Water Quantity	12
6.1 Domestic and Industrial Consumption	12
6.11 Industrial Consumption	12
6.12 Domestic or Lake Property Owner Consumption	13
6.2 Climate-Based Extremes	13
6.21 Lake Community Planning for Droughts and Floods	13
6.3 Drainage	14
6.4 Upstream and Downstream Commitments	14
7.0 Shoreline Management	15
7.1 Protecting Existing Shoreline and Riparian Areas	15
7.11 Off-Site Watering and Exclusion Fencing for Livestock	15
7.12 Conservation Easements	16
7.13 Zoning or Land Use Regulations	16
7.2 Implementing Enhancement Projects to Restore Riparian Areas	16
7.21 Riparian Area Plantings	16
8.0 Lake Property Infrastructure	17
8.1 Implementation Plans	17
8.2 Lake Friendly Infrastructure	17
8.3 Sharing of Infrastructure	18
9.0 Aquatic Ecosystems	18
9.1 Invasive Species Management	18
9.11 Prevention	19
9.12 Monitoring	19
9.13 Control	20
9.2 Sustainable Harvest	20
9.3 Pollution Prevention	20
9.4 Habitat Conservation	21
10.0 Conclusion	21
11.0 Appendix	22
12.0 Glossary	25
13.0 List of Acronyms	26
14.0 List of Legislation and Governing Agencies	26
15.0 Additional Resources and Contacts	27
16.0 Literature Cited	28



1.0 EXECUTIVE SUMMARY

Lakes are essential for life and health in Saskatchewan. One way to protect lakes is through lake stewardship. Lake stewardship involves resort communities, lake property owners, lake users, municipalities, government agencies, Indigenous governments, Indigenous communities, non-government organizations, and industrial operations working together to preserve or enhance lake health. The Saskatchewan Association of Watersheds Lake Stewardship Strategy provides a province-wide approach to lake stewardship and includes best-management practices (BMPs) that can address the challenges that Saskatchewan lakes face.

The goal of the strategy is to identify lake stewardship BMPs for Saskatchewan lakes and facilitate the implementation of practices to improve lake sustainability. To accomplish this, the Saskatchewan Association of Watersheds (SAW) developed a lake stewardship steering committee and used their experience and knowledge to guide the development of the strategy. The strategy identifies components of lakes that are under threat, including water quality, water quantity, shorelines, lake property infrastructure, and aquatic ecosystems. Relevant legislation and laws pertaining to Saskatchewan lakes are outlined, and agencies responsible for the implementation, administration, and enforcement of legislation are identified.

2.0 INTRODUCTION

Saskatchewan is home to an estimated over 100,000 lakes representing some of the most abundant freshwater resources in North America. Lakes are a critical component to life in Saskatchewan. They are a drinking water source that serves about 72% of Saskatchewan's population, provide a living environment for aquatic and terrestrial organisms, and provide recreational and aesthetic benefits to thousands of users annually.

Saskatchewan's lakes are continually threatened by climate change, eutrophication, aquatic invasive species, erosion and sediment loading, and more. Lake stewardship addresses these threats through a collaborative approach to take care of our lakes as a community. In this case, different stakeholders and organizations work together to implement practices that ensure our lakes remain healthy for future generations.

The strategy summarizes the major challenges impacting each lake component and establishes a framework of practices that address each challenge. Lastly, the strategy and integrated fact sheets (Appendix) depict how the BMPs can be used to effectively apply lake stewardship principles.

Overall, the strategy is an educational tool that can be used to implement a variety of lake stewardship BMPs by a wide range of lake-reliant groups. The strategy emphasizes the importance of collaboration, leading to more engagement and consideration for collaborative-based approaches to enhance lake sustainability for future generations. Finally, the practicality of lake stewardship practices ensures decision makers are best informed and consider lake stewardship when designing and implementing future policy. The strategy should be continually revisited as lake stewardship challenges, practices, and sustainability priorities change over time.

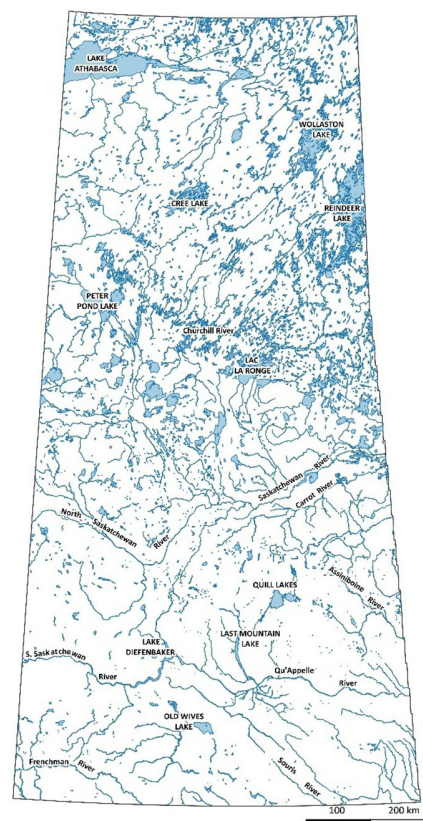


Figure 1: Hydrology of Saskatchewan (Statistics Canada, 2011a; 2011b)

3.0 BACKGROUND

Over the last century, lake usage in Saskatchewan has dramatically increased. Lake communities, industrial operations, and recreation have rapidly expanded, creating challenges for lake water quality, quantity, infrastructure, shorelines, and ecosystems. As a result of these challenges, changes in lake health are becoming more noticeable. Initial concerns about Saskatchewan lake health have been driven by lake property owners, who noticed deteriorating water quality. However, more recently, entire communities and lake user groups have vocalized concerns about the health of lakes across the province. Growing concerns about the long-term sustainability of Saskatchewan lakes have given rise to a need for lake stewardship. To address this need, the Saskatchewan Association of Watersheds (SAW) has developed this lake stewardship strategy as a tool to improve lake sustainability.

The development of this strategy was guided by a lake stewardship steering committee which included representatives from SAW, the Water Security Agency (WSA), resort communities, Indigenous communities, watershed associations, and rural municipalities (RMs). The purpose of the steering committee was to engage lake users from a variety of backgrounds and perspectives and use their experiences to guide the development of a written lake stewardship

strategy. The Saskatchewan Association of Watersheds Lake Stewardship Strategy includes the following objectives:

- A. Identify key challenges to Saskatchewan's water resources and describe how lake components are impacted by each.
- B. Outline relevant legislation pertaining to Saskatchewan lakes and identify what groups or agencies can address each challenge.
- C. Develop a series of lake stewardship BMPs that can be implemented to address challenges and educate lake communities, property owners, municipalities, industrial operations, non-profit organizations, and Indigenous communities on lake stewardship.
- D. Collaborate with lake users, agencies, and groups to efficiently implement lake stewardship practices to improve Saskatchewan's freshwater resources.

To implement a strategy, we need to understand the components of lake stewardship. These components include water quality, water quantity, shoreline management, lake property infrastructure, and the aquatic ecosystem. They influence one another and are intrinsically linked (Figure 2). For example, shoreline management is land-based, but directly impacts water quality, water quantity, and the aquatic ecosystem. To address challenges that cover multiple components, BMPs recommended in this strategy are approached from a holistic perspective to improve lake health in the most efficient and effective way possible.

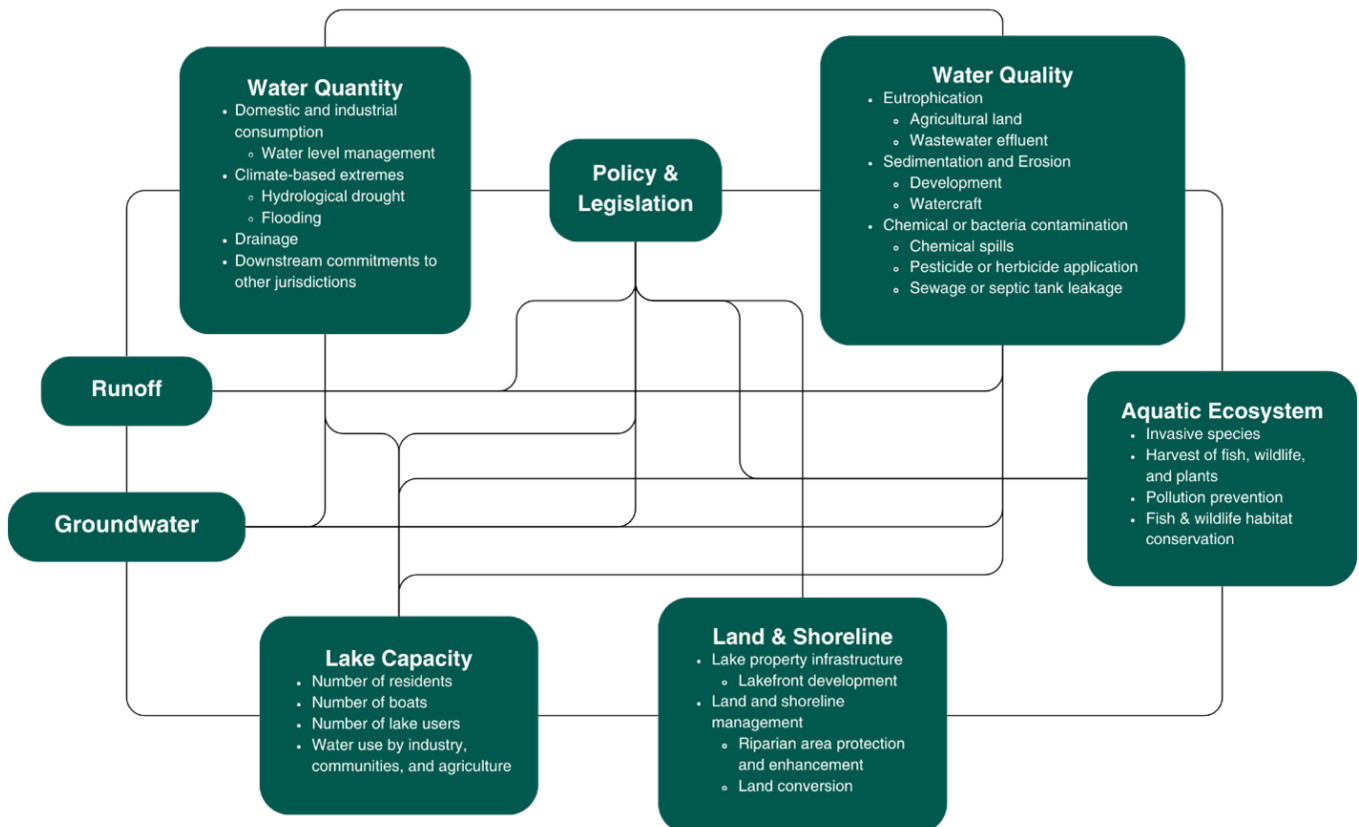


Figure 2: Outline of lake stewardship components and challenges. Lines connecting shapes indicate intrinsic links among various components.



4.0 LEGISLATION PROTECTING SASKATCHEWAN LAKES

Understanding the laws and regulations protecting Saskatchewan lakes allows for the most effective implementation of lake stewardship practices. Within Saskatchewan, federal and provincial legislation protecting lakes exists across public and private jurisdictions. Agencies responsible for developing and implementing the rules and regulations include the Water Security Agency (WSA), Saskatchewan Ministry of Environment (MoE), and Fisheries and Oceans Canada (DFO). Rules and regulations can also be enforced by police officers, Conservation Officers, and Environmental Protection Officers.

In Saskatchewan, the water, bed, and shore of lakes is public and protected by *The Environmental Management and Protection Act, 2010 (EMPA)*. The distance where public shoreline becomes private land depends on the land title and survey plan; however, any activities that modify a lake including the water, vegetation, bed, bank, or boundary within 5.0 metres of the ordinary water level require approval from WSA and must adhere to the EMPA. Approval from WSA is typically acquired through a standard Aquatic Habitat Protection Permit (AHPP), but alternative means of acquiring approval can be sought through an Environmental Protection Plan (EPP) for shoreline stabilization or bridge maintenance, repair, and replacement. Additionally, works that affect navigation on lakes (or any navigable waters) in Canada require approval via the *Canadian Navigable Waters Act, 2019*.

Land beyond the bed and shore also impacts lake health and must be considered for lake stewardship. Sewage, septic, storm water, wastewater, or other pollutive discharge on any

land running into lakes is enforced by *The Shoreland Pollution Control Regulations, 1976*. *The Provincial Lands Act, 2016* outlines activities authorized on public land and *The Wildlife Habitat Protection Act, 1984* protects habitat and ecological lands. Private land along lakes beyond the bed and shore is not subject to either legislation. However, *The Municipalities Act, 2005* and *The Cities Act, 2002* enable municipal governments to create environmental reserves or bylaws on municipal land, allowing for further lake protection. Agricultural land and intensive livestock operations in Saskatchewan are regulated by *The Agricultural Operations Act, 1995*.

Fish and wildlife existing in, on, or around lakes is public, and protected by *The Fisheries Act, 2020* and *The Wildlife Act, 1998*. *The Fisheries Act, 2020* also identifies prohibited aquatic invasive species, mandatory stopping at watercraft inspection stations, removal of drain plugs while transporting watercraft, and mandatory reporting of invasive species. *The Fisheries Regulations, 1995* enable management of fish stocks and recreational and commercial angling, further protecting lake resources. The federal *Fisheries Act, 1985*, also safeguards lakes by outlining approvals for activities in or near fish-bearing waterbodies.

Overall, the administration of laws to protect lakes in Saskatchewan is the shared responsibility of provincial and federal agencies. However, it is not the sole responsibility of the government to protect lakes. Resort communities, industrial operations, Indigenous governments, Indigenous communities, and lake users must also work together to do their part to protect lakes.

5.0 WATER QUALITY

Lake water quality plays a pivotal role in supporting life and health in Saskatchewan and must be protected. However, water quality in Saskatchewan lakes continues to be threatened, and is now likely the single greatest concern for lake communities and lake users. Challenges including eutrophication, sedimentation and erosion, and chemical or bacterial contamination alter water quality in lakes, causing algae blooms, loss of habitat, fish and wildlife deaths, and human sickness. These effects harm lake sustainability and may result in depreciation of lake property values. To address water quality challenges, lake stewardship BMPs such as reducing fertilizer use, improving wastewater treatment, limiting lakefront development, and water quality monitoring programs can be implemented.

5.1 EUTROPHICATION

Since the early 1900s, lakes in Saskatchewan have been subject to cultural eutrophication. Eutrophication is the process where nutrients gradually accumulate in a lake, resulting in increased growth of organisms such as algae which can deplete oxygen in the water. Although this is a naturally occurring process, the speed at which it occurs can be greatly altered by human activities. In Saskatchewan, nutrient loading of nitrogen and

phosphorus from runoff, fertilizer use, and wastewater effluent can increase the rate of eutrophication. This can lead to more frequent and severe green and blue-green algae blooms, which are unpleasant to see and smell but can also pose severe health risks to humans and animals if consumed. Algae blooms may also increase the costs of water treatment, costing lake communities and municipalities thousands of dollars each year.

5.11 *Agricultural or Converted Land*

To limit eutrophication, on-farm land-management practices can be used to reduce nutrient transport from agricultural land to lakes. Implementing polymer coated urea fertilizer, annual soil testing and mapping, effective crop rotations, zero-tillage, GPS, cover cropping and split application of fertilizer will reduce fertilizer use, resulting in less available nutrients to runoff into lakes. Livestock management practices can also be implemented. Producers may consider avoiding spreading manure on land directly adjacent to lakes or properly storing and managing manure so that it does not leach into lakes via runoff. Utilizing perennial forage near lake shorelines, maintaining riparian buffer strips along lakes, and leaving vegetation in drainage channels that discharge into lakes can also reduce

eutrophication by trapping nutrients and sediments before they reach a lake.

Lake property owners can implement many of these same strategies if their land has been converted to non-native grass at residences or golf courses. Reducing grass fertilizer usage, avoiding fertilizers that contain phosphorus, and only fertilizing when needed will limit nutrient availability during runoff events. Property owners should consider preserving native landscapes that naturally act as buffers or filters and reduce the amount of nutrients that run off into lakes, as opposed to converting land into non-native grass at residences and golf courses.





5.12 Wastewater

To prevent eutrophication, wastewater effluent is regulated by the WSA and monitored by Environmental Protection Officers (EPOs) via *The Waterworks and Sewer Works Regulations, 2015*. The legislation outlines wastewater standards, minimum treatment requirements, monitoring intervals, facility/lagoon requirements, and required certifications for water treatment. Lake communities and industrial operations must follow wastewater treatment guidelines to protect lakes.

Although minimum standards for wastewater treatment must always be met, lake communities or industrial operations can further prevent eutrophication by upgrading their wastewater treatment facilities to achieve the highest water quality standards possible. Costs of upgraded wastewater facilities are not always feasible, so communities might consider collaborating with municipalities and seeking assistance from government programs such as the Government of Canada’s Clean Water and Wastewater Fund Program to improve wastewater treatment systems.

Lake communities can also integrate tertiary water treatment practices such as installing floating treatment wetlands on stormwater ponds or lagoons to improve water quality, particularly where ponds or lagoons overflow into lakes during flood events. Floating treatment wetlands capture excess nutrients and common pollutants from the water, improving water quality. The shelter provided by floating treatment wetlands allows sediments to settle by reducing turbulence and mixing by wind and waves and provides habitat for lake-dependent species.

Educating lake property owners on the importance of wastewater treatment and proper wastewater disposal may also help improve water quality. If property owners understand that water treatment can help preserve lake water quality, they may be more inclined to invest in water treatment systems and facilities. Additionally, lake property owners should appropriately manage their wastewater wherever possible. For example, property owners should refrain from draining wastewater from hot tubs or swimming pools into their lake, and instead have wastewater pumped out via a septic service.

5.2 SEDIMENTATION AND EROSION

As the number and density of lakefront developments and lake users increases in Saskatchewan, sedimentation and erosion become more problematic. For example, as more natural lakefront areas are converted into beaches or properties, erosion increases because less sediment is trapped on shore by natural vegetation. Additionally, rising and lowering water levels from floods or reservoir management can cause bank

slumping and erosion issues. Watercraft activity on lakes can also create unnatural wave action, further eroding shorelines. These activities degrade water quality by releasing trapped nutrients and increasing suspended or dissolved solids which deposit and slowly fill in lakes. This harms aquatic habitat and organisms, increases costs of water treatment, and damages lake property infrastructure such as water intakes.





5.21 Lakefront Development

Sedimentation and erosion in Saskatchewan lakes should be addressed at the source, and that begins with lakefront property. While BMPs for property owners are addressed in the Shoreline Management section of this strategy, an initial practice to consider is to limit the development of lakefront property. Limiting lakefront development will reduce sedimentation, erosion, and eutrophication. To achieve this, communities, municipalities, and developers must be better educated on the impacts lakefront development has on lakes. Lake stewardship fact sheets (Appendix) such as those included within this strategy can be provided to property buyers, property owners, communities, or groups considering lakefront development, better educating them on lake stewardship practices. Additionally, resort communities and municipalities should collaborate to assess development on their lakes. Often referred to as Lake Management Plans, these assessments provide an overview of current lake water quality, lakefront development, lake use, number of users, and whether the lake is overdeveloped or not. Lake Management Plans would help resort communities and municipalities measure risk to their lake if development continues.

When development of lakefront property must proceed, developers, communities, or municipalities must adhere to existing legislation including *The Environmental Management and Protection Act, 2010* and *The Shoreland Pollution Control Regulations, 1976* and apply for appropriate permits such as aquatic habitat protection permits (AHPPs) through the

WSA. Developers can engage stakeholder groups including other communities, municipalities, lake users, and Indigenous communities before beginning construction, enabling communication and allowing concerns to be fielded in advance. Developers and stakeholders should work together to find solutions to lake concerns. Open and transparent dialogue between developers and stakeholders would be highly beneficial for preserving important lakefront areas, reducing sedimentation, and limiting erosion.

When lakefront construction does occur, proper sediment and erosion control measures must be implemented as instructed per AHPP permit approvals provided by WSA. Installation of sedimentation stops or barriers should be made as soon as permits have been issued and prior to any vegetation removal. Shoreline slopes must be properly graded and stabilized to keep erosion to a minimum. Structures including silt fences, sediment blankets, plastic sheeting, and turbidity curtains must be installed to reduce erosion and sedimentation during construction. When construction is complete, bank stabilization methods including retaining walls, riprap, and native vegetation replanting can be used to keep shorelines intact and stop erosion. Additionally, developers should refrain from paving lots with impervious materials such as asphalt or cement, as these materials may increase eutrophication by decreasing the amount of natural land and vegetation that traps nutrients during runoff events.



5.22 Watercraft

Erosion caused by unnatural wave action from watercraft including wake boats, jet skis, and fishing vessels during recreational activities is a large concern for lake communities, especially when wave action occurs within 15 metres of shore. In small lakes with high numbers of watercraft, the potential for erosion is higher. These activities can resuspend sediments and decrease water quality, damage fish habitat, and wash away bird nests, eggs, and young.

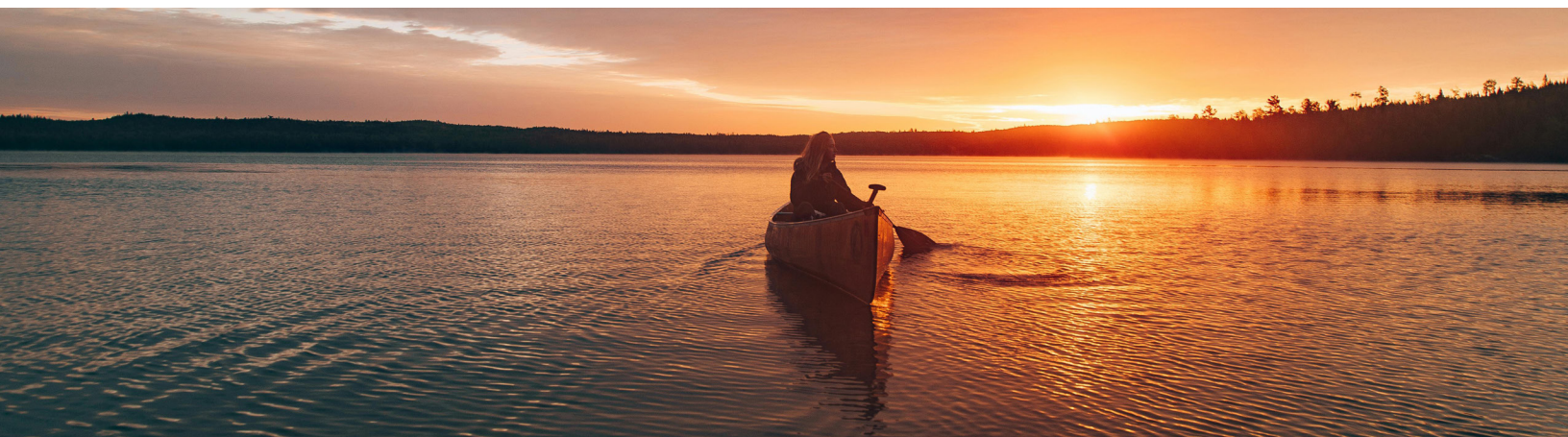
This could be addressed by improved regulations and enforcement of watercraft activity on lakes. However, this is overseen by Transport Canada, and lake

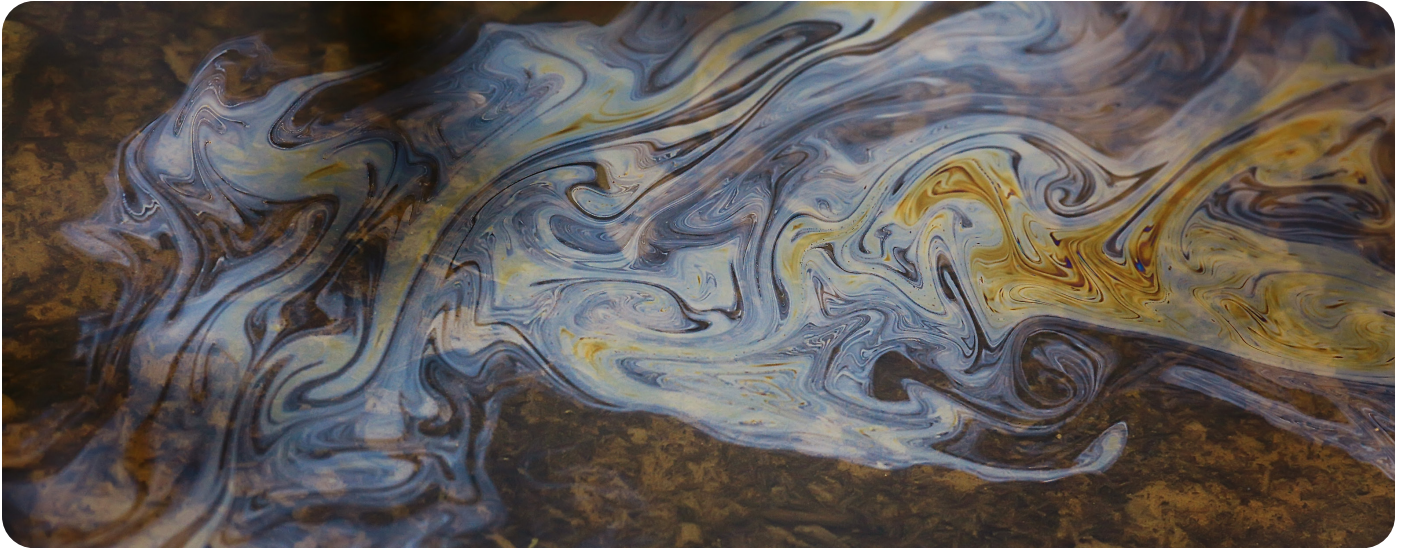
communities cannot implement enforceable bylaws for watercraft as it is not within their jurisdiction. Instead, lake communities should focus on educating residents and lake users on boating practices that limit wake-based erosion, such as slowing down to less than 10 kilometers per hour when within 30 metres of shore and refraining from loading boat ballasts with water while driving. Installing educational signs or posters near boat launches, providing educational brochures or pamphlets to lake community residents or user groups, and hosting information sessions during the summer months could reduce boater practices causing erosion.

5.3 CHEMICAL OR BACTERIAL CONTAMINATION

Chemical or bacterial contamination comes in many forms and is another challenge to lake health. For example, oil, gas, or chemical spills, leaks or seepage from septic tanks, and pesticide and herbicide application can harm vegetation,

wildlife, and habitat. Although contamination might never be fully eliminated, properly cleaning spills, reducing chemical, pesticide, and herbicide use, and proper septic tank maintenance can help keep lakes healthy.





5.31 Large-Scale Spills

Large-scale spills of oil, gas, or other chemical contaminants come from a variety of sources, including pipeline ruptures, boat, rail, or truck wreckages, and by-products from mining or forestry operations. To prevent lake contamination, communities and industrial operations must follow regulations for the contaminants they encounter and should choose to transport contaminants on routes that will not impact a lake if there is a spill. Transport lines and equipment can be regularly inspected for leaks, and major spillage of any contaminant must be immediately reported to the government per the *Canadian Environmental Protection Act, 1999* so that proper remediation can be implemented. Chemical cleanup and site remediation must be done to required standards to reduce downstream effects of contamination.

5.32 Lake Property Owner Spills and Chemical, Pesticide, or Herbicide Use

Lake property owners can also do their part to prevent chemical contamination of a lake. Using proper care and equipment when filling watercraft with gas or removing wastewater from houseboats, avoiding the use of chemicals to clean watercraft or infrastructure, and refraining from spraying pesticides or herbicides will prevent contamination. If chemicals cannot be avoided, property owners can opt for environmentally friendly phosphorus-free detergents, cleaners, pesticides, or herbicides that are approved for use near water. When a spill occurs, property owners should clean up the spill immediately to prevent chemical runoff into the lake.



5.33 Sewage or Septic Tank Leakage

Sewage line or septic tank leakage from lake communities is a contributor to eutrophication and chemical or bacterial contamination in lakes, particularly in communities with aging infrastructure. Leaks can result in untreated sewage containing bacteria such as *Escherichia coli* (E. Coli), *Salmonella*, and *Giardia Lamblia* entering a lake. These bacteria are extremely dangerous, potentially causing sickness in wildlife or humans.

Lake property owners should have any leaking sewage infrastructure or septic tanks immediately replaced to minimize contamination. Older septic tanks can be frequently inspected and proactively replaced to limit future possible septic leakage. Lake property owners might consider having new septic tanks inspected on a 3–5-year basis, while RMs or resort communities can implement bylaws that force residents to have their septic

tanks inspected routinely. RMs and resort communities can document septic pump out records and alert ratepayers that are not routinely pumping out or maintaining septic tanks, as this may indicate leakage.

To prevent future leakage, proper planning must be used when implementing new septic or sewage systems. New septic tank installations must abide by the *Shoreland Pollution Control Regulations, 1976* and be installed as far away from the lake as possible, but where they are still accessible for routine inspection, maintenance, or repair. New installations must have proper fail-safes including back up pump outs, appropriately sized risers and covers, distribution boxes, highwater alarms, and filter or geotextile fabric installed beneath to stop any septic leakage from entering the lake.

5.4 WATER QUALITY MONITORING FOR COMMUNITIES

Implementation of lake stewardship practices that address eutrophication, sedimentation, and contamination are a positive step towards protecting lake water quality. However, the addition of a volunteer, citizen science-based water quality monitoring program such as the Alberta Lake Management Society's LakeWatch Program can provide early detection of changes to water quality and broaden understanding of overall lake health.

In a citizen science water quality monitoring program, parameters including temperature, pH, conductivity, salinity, turbidity, chlorophyll-a, dissolved oxygen, total suspended solids, and total dissolved solids can be measured by volunteers using YSI meters at a variety of sites across a lake. Sites are monitored on a monthly or bi-monthly basis year-round, aiming to provide a comprehensive dataset on water quality parameters. This data is stored in a shared repository, informing lake communities of trends in water quality over time and providing early detection of unreported contamination, which is critical for protecting lakes.

The more participants there are, the more comprehensive and informative the dataset will be. Thus, citizen scientists or volunteers should come from lake communities, First Nations communities, lake user groups, wildlife federations, non-profit environmental organizations, industrial operations, and work together with government agencies to proactively monitor water quality. Data must be collected in a consistent manner if it is going to be compared across areas and years, so collaboration and communication amongst groups conducting water quality monitoring is key. Organized monitoring by multiple groups will generate large, detailed datasets to aid in decision making. Monitoring programs like this are currently implemented by the Alberta Lake Management Society and British Columbia Lake Stewardship Society to ensure lake sustainability in each jurisdiction. The adoption and implementation of this type of programming in Saskatchewan would be a key step towards comprehensive lake stewardship.



6.0 WATER QUANTITY

Water quantity is a critical component of lake stewardship – if there is no water, there is no lake. Additionally, water quantity dictates water availability for domestic and industrial use, fish habitat, and recreational area. Challenges for water quantity include domestic and industrial consumption, climate-based extreme events such as increased frequency and severity of drought and flooding, drainage, and upstream or downstream commitments to other jurisdictions.

Water quantity is managed by WSA through the management of dams, weirs, or other control structures that allow for the impoundment or release of water. The impoundment of water via a dam creates a “reservoir”, which is simply a man-made lake. For simplicity, we consider both natural lakes and reservoirs the same in this strategy. Managing water quantity via impoundments is done for a variety of reasons, including hydro power generation, irrigation, and legal agreements with downstream provincial and international users. These requirements and understanding that WSA is the agency responsible for managing water quantity in lakes must be considered when implementing lake stewardship BMPs.

6.1 DOMESTIC AND INDUSTRIAL CONSUMPTION

Lakes in Saskatchewan provide the water that communities and industry consume daily. For example, Buffalo Pound Lake provides water for businesses and more than 250,000 residents in the cities of Moose Jaw and Regina while simultaneously supporting two potash mines. To first address lake water consumption, communities and industrial operations should work closely with the government when

monitoring water intake to provide the best possible data regarding water use and quality. Lake communities, industrial operations, and the government can use water intake data when developing Lake Management Plans, identifying key consumers, current water consumption amounts, predicted future consumption amounts, and what the appropriate lake levels are to sustain human use and habitat.

6.11 Industrial Consumption

Industrial operations such as intensive livestock operations, agricultural irrigation, mines, and forestry mills can also limit consumption of water. Surface cleaning at mills and mines can be done with brooms, mops, squeegees, and vacuum cleaners instead of hosing surfaces down. Industrial operations might also reconsider the need to wash building exteriors or other outside structures, reducing the frequency of cleaning external equipment, changing cleaning schedules from ‘regular’ to ‘as required’, and only washing vehicles when needed. Investing in modern water saving equipment such as automatic shut-

off valves, timers, submetering systems, closed loop cooling systems, low water use nozzles, and leak and flow monitors will also limit water consumption by mills, mines, and irrigators. Old equipment can be upgraded to water efficient models wherever possible, as well. For example, high-volume cleaning systems can be swapped to low-volume systems with aerated spray nozzles to minimize water use for cleaning. Industrial operations can treat, reuse, and recycle water, and partner with irrigators or neighboring operations to maximize water application once drawn from a lake.





6.12 Domestic or Lake Property Owner Consumption

Lake property owners and community members can also reduce water consumption. Property owners should fix leaking lines, faucets, or fixtures, restrict grass or garden watering to cool times of day, use rain catchers or barrels to store rainwater for later use, and repurpose grey water for use if possible. Reducing the size of a lawn and using soaker hoses or drip irrigation for watering can also limit water consumption

from a lake. Property owners should upgrade to the most water efficient toilets, showerheads, and taps to preserve water, and replace old washing machines, washers, and dryers with high efficiency models. Refraining from using water to clean driveways, steps, decks, and docks, and instead sweeping or using a leaf blower to clean these areas also limits water consumption.

6.2 CLIMATE-BASED EXTREMES

Many Saskatchewan lakes are replenished annually via spring or precipitation runoff, glacial meltwater, or temporary groundwater springs, and are highly susceptible to extremes brought on by climate change such as drought and flooding. During a hydrological drought, water replenishment rates

decrease and lake levels lower. This can leave community water intakes high and dry, while limiting water availability for other users. Conversely, during a flood event, massive surges of water moving into a lake can destroy lake property infrastructure, water control structures, and habitat.

6.21 Lake Community Planning for Droughts and Floods

To address extreme events, lake communities should develop emergency response plans for droughts and floods, especially if the community uses lake water for domestic purposes or is in an area susceptible to flooding. Emergency response plans are a proactive strategy to prepare for extreme events such as droughts and flooding and will become increasingly important as extreme events associated with climate change become

more frequent and severe. Plans should outline baseline water consumption amounts, water rationing guidelines during drought, and barrier placement or emergency evacuation guidelines during floods. Additionally, lake communities should develop general water use guidelines and educational material to inform residents on how to save water, enabling them to be more resilient to drought.



6.3 DRAINAGE

Drainage of wetlands from agricultural land or stormwater from cities into lakes can also greatly influence water quantity. Drainage alters water movement on the landscape, oftentimes concentrating the flow of water from large sections of land into a highly specific outflow location. This concentration of water can increase runoff amounts into lakes, resulting in greater chances for flooding during snowmelt or severe rainfall events.

To address these issues, drainage should be done in a sustainable manner. Drainage on agricultural land can aim to retain as many wetlands as possible to preserve the natural flow of water on the landscape, and drainage networks should

aim to slow the velocity of runoff to reduce erosion. Drainage networks must consider all parties with land or water involved in the network, including lake communities and downstream users. Developers should consider implementing drainage management plans when developing property near lakes, to ensure drainage is minimally impactful. Stormwater drainage by cities can utilize retention ponds with floating treatment wetlands to remove contaminants and allow sediments to settle prior to releasing water into lakes. Additionally, cities and municipalities might consider basic treatment of stormwater where possible to remove harmful contaminants and bacteria, prior to discharging into lakes.

6.4 UPSTREAM AND DOWNSTREAM COMMITMENTS

Several key agreements addressing water apportionment exist between Saskatchewan and other jurisdictions. The *Master Agreement on Apportionment, 1969* outlines water apportionment agreements between Saskatchewan, Alberta, and Manitoba, and is administered by an intergovernmental organization called the Prairie Provinces Water Board, which is legislated into the agreement. *The Boundary Waters Treaty, 1909* acts similarly, and outlines water apportionment agreements between Canadian provinces and the United States through the International Joint Commission (IJC). These

commitments of water to other jurisdictions are legislated and cannot be avoided without legal repercussions. For example, Saskatchewan is required by law to provide 50 per cent of the water it receives in natural flow from the Province of Alberta to the Province of Manitoba. Additionally, the IJC orders the apportionment of water in the Poplar River and Milk River basins from Saskatchewan to the United States. To best protect water quantity, lake communities should improve their understanding of these agreements and learn how they influence water quantity in their lake.

7.0 SHORELINE MANAGEMENT

Healthy shorelines and riparian areas are an important component of a functioning lake. For example, root systems from riparian vegetation stabilize soil and prevent erosion, withholding nutrients and sediment. This vegetation acts as a natural buffer or filter during runoff events, improving water quality by regulating water flow and reducing nutrient and sediment entry into the lake. Riparian areas also enhance biodiversity and provide important habitat for wildlife. Unfortunately, riparian areas are frequently damaged or lost due to livestock and human development. To keep lakes healthy, practices that focus on a) protecting existing shoreline and riparian areas, and b) implementing enhancement projects to restore degraded riparian areas should be considered.

7.1 PROTECTING EXISTING SHORELINE AND RIPARIAN AREAS

Protecting existing shoreline and riparian areas from conversion or damage limits further degradation of lake water quality. As a result, property owners and lake communities should refrain from altering shorelines and lake property frontage and instead leave it in its natural state. Other lake stewardship practices

that focus on protecting existing riparian areas including off-site watering or exclusion fencing for livestock, conservation easements, and zoning or land use regulations can also be used to manage shorelines and maintain lake health.

7.11 Off-Site Watering and Exclusion Fencing for Livestock Areas

Livestock accessing lake shorelines to drink causes high levels of disturbance in established riparian areas and can kill off riparian vegetation. Methods for limiting livestock accessibility to riparian areas include the installation of off-site watering systems and exclusion fencing. Off-site watering systems allow water from the lake to be pumped to an external watering trough using solar power, limiting the need for livestock to walk through riparian areas to drink.

Exclusion fencing can be used in conjunction with off-site watering systems to protect riparian areas. By installing permanent barbed wire or temporary electric fences along the

outskirts of riparian areas, producers can eliminate livestock damage to riparian vegetation, protecting these areas and maintaining lake health. The combination of watering systems and exclusion fencing not only helps lakes, but also provides livestock with cleaner water to drink, improving stock condition. Agricultural producers should seek financial assistance from government and non-profit organization rebate programs, including the Ministry of Environment's Farm and Ranch Water Infrastructure Program (FRWIP) and SAW's Saskatchewan Watershed Environmental Agriculture Program (SWEAP) to help cover project implementation costs.



7.12 Conservation Easements

Conservation easement programs offered by government agencies and non-profit organizations could be used by lake property owners wherever possible to protect existing riparian areas and shoreline. Conservation easements are legally binding agreements that provide financial benefit to property owners for restricting development of critical areas on their property for 5-year, 10-year, or perpetuity timeframes. Most easements focus on preserving wetlands, but programs offered by government agencies and non-government organizations

such as the Saskatchewan Ministry of Environment, Nature Saskatchewan, and Ducks Unlimited Canada can also include easements for riparian areas and shoreline. By providing financial reward for preserving riparian areas on private land, property owners who were considering removing or converting these areas may be more inclined to retain them. Conservation easement programs have been highly successful in retaining wetlands and uplands and should be pursued further to maximize riparian area or shoreline retention.

7.13 Zoning or Land Use Regulations

Communities and municipalities should enact zoning and land use bylaws that restrict development and disturbance of riparian areas to keep lakes healthy. Zoning laws for new properties can limit development, construction, or other

activities that degrade existing riparian areas, and land use regulations for existing properties can prevent lake property owners from removing riparian areas.

7.2 IMPLEMENTING ENHANCEMENT PROJECTS TO RESTORE RIPARIAN AREAS

At many lakes across Saskatchewan, riparian areas are already damaged or lost because of lakefront development and infrastructure. However, riparian areas can be remediated using enhancement projects, which restore the natural buffer and

filter effect of riparian areas to improve lake health. To achieve this, enhancement projects such as riparian area plantings need to be implemented by property owners.

7.21 Riparian Area Plantings

Planting native vegetation in degraded riparian areas is a simple, cost-effective way to enhance lake health. Riparian planting of a variety of native shrub and tree seedlings or saplings such as willows, dogwood, chokecherry, Saskatoon berry, birch, aspen, and poplar will restore riparian areas to their previous size, density, and capabilities. Riparian plantings usually include

proper site preparation, so equipment for tillage and mulch, staking and wrapping of trees or shrubs, and timely planting and watering are crucial for successful enhancement. Lake property owners and communities should partner with non-profit or government organizations wherever possible to maximize funding and support for riparian enhancement projects.





8.0 LAKE PROPERTY INFRASTRUCTURE

Implementation of infrastructure on lake property poses challenges for lakes. Installing boat launches, marinas, boardwalks, piers, docks, lifts, and sand beaches destabilizes the shoreline and bed, destroys aquatic plants, and disrupts fish habitat. Infrastructure can also act as additional debris or hazards during high water years. Lake stewardship BMPs including implementation plans, lake friendly infrastructure, and sharing of infrastructure can educate lake property owners and keep lakes healthy while still allowing for lake enjoyment.

8.1 Implementation Plans

Implementation plans must be used by landowners when installing lake property infrastructure. Plans should address proper design, timing, setbacks, and materials for infrastructure, and outline site protection methods during construction including sediment barriers or turbidity curtains. Plans must be aligned with provincial and federal regulations and be approved

by WSA and DFO where required. Property owners should avoid dredging the lake bottom or importing fill and sand when installing infrastructure, and refrain from permanently installing infrastructure as it may become hazardous in the winter or during high water years.

8.2 Lake Friendly Infrastructure

When infrastructure such as docks or swimming platforms are implemented, property owners should use lake friendly versions. For example, using floating docks or swimming platforms instead of permanently installed ones attached to the lake bottom will result in less disturbance to the bottom and bed of the lake. Property owners should choose docks or platforms without EPS foam or chemical coatings and avoid painting or staining docks, as these will leach chemicals into the

water as the dock or platform degrades in the sun over time. Instead of boat lifts, property owners should implement track and dolly systems to move boats in and out of boathouses to further minimize disturbance to the lake bottom, shoreline, and riparian area. To access lake infrastructure, property owners should only cut small trails down to the shoreline, aiming to retain as much vegetation and riparian area as possible.



8.3 Sharing of Infrastructure

Property owners should seek to share existing private infrastructure wherever possible. Sharing private marinas, docks, piers, swimming platforms, and boat launches will allow more people to enjoy the lake without adding infrastructure, keeping the lake healthier. Additionally, property owners

should try to use public infrastructure wherever possible, instead of implementing their own. Using existing public beaches, marinas, boat launches, piers, trails, and roads allows property owners to enjoy the lake without having to add or upkeep private infrastructure.

9.0 AQUATIC ECOSYSTEMS

Often acting as an indicator of lake health, a diverse and functioning aquatic ecosystem is an integral component of Saskatchewan lakes. However, aquatic ecosystems in lakes are threatened by invasive species, overharvest, pollution, and habitat loss. To preserve aquatic ecosystems and keep lakes healthy, lake stewardship BMPs including invasive species management, sustainable harvest, pollution prevention, and habitat conservation should be practiced by all lake users.

9.1 INVASIVE SPECIES MANAGEMENT

Invasive species in lakes come in many forms including fish, animals, plants, algae, and bacteria. Invasive species associated with water are called aquatic invasive species (AIS). Some AIS that threaten Saskatchewan lakes include zebra and quagga mussels, Prussian carp, goldfish, and spiny water flea. Other invasive species that are not aquatic but exist along lake shorelines include leafy spurge and purple loosestrife.

These organisms damage lake infrastructure by clogging water intakes and harm aquatic ecosystems by displacing or outcompeting native species and degrading water quality and habitat. Addressing invasive species once they are established can cost millions of dollars, so proper prevention, monitoring, and control of invasive species is key for sustaining lake health.

9.11 Prevention

Preventing the introduction of invasive species to lakes is the most cost-effective way to limit their impacts. However, for proper prevention, all lake users must adhere to laws and lake stewardship practices. First, lake users should clean, drain, and dry their watercraft, fishing gear, swimming items, and any non-permanent infrastructure after each use, following guidelines provided by the Government of Saskatchewan Ministry of Environment's Clean, Drain, Dry Program. Clean, drain, dry includes rinsing, scrubbing, or washing equipment with hot water, removing visible plants and animals, draining excess or standing water, and drying with a paper towel or rag. This restricts the ability of invasive mussels, plants, or other organisms to attach themselves to watercraft or equipment and be transported from one affected lake to another. When watercraft or equipment is transported across jurisdictions or into Saskatchewan, lake users must stop at a mandatory Government of Saskatchewan Watercraft Inspection Station to have their watercraft inspected and decontaminated.

9.12 Monitoring

Prevention of invasive species may not always be possible, but monitoring at confirmed sites along with random monitoring is effective at managing spread and severity. Resort communities, Indigenous communities, industrial operations, non-government organizations, and government agencies should collaborate on monitoring programs for species that are at high-risk of being transferred among lakes, including Zebra Mussels, Goldfish, Prussian Carp, Flowering Rush, and Leafy Spurge. The Government of Saskatchewan currently spearheads monitoring programs, but lake users, resort communities, and non-government organizations should participate to strengthen our understanding of their distribution. One popular

Accidental or purposeful release of invasive species into lakes can also be prevented. Species such as goldfish and Koi are often kept as pets and discarded into lakes by owners when no longer desired. Pet fish, wildlife, or their remains should not be released or discarded in lakes. Lake community residents can also avoid planting or introducing non-native plants on their property, as these can spread into the lake or along shorelines. To further prevent invasive species, communities should partner with the Government of Saskatchewan to educate lake property owners and residents on how to identify common invasive species. Growing the cohort of lake users that can identify and report invasive species would assist with monitoring programs such as the Saskatchewan Conservation Data Center's iMapInvasives Program, which aims to share information about invasive species to aid in strategic management.

monitoring program is the adult invasive mussel monitoring program, which provides participants with substrate samplers that are hung from their dock in the lake, acting as artificial surfaces for larval mussels to settle on. Samples are checked multiple times throughout the open water season for the presence of invasive mussels. The program is open to the public, so any lake property owner can participate. Collaborative monitoring of existing invasive species and for new potential invasive species will enable the earliest possible detection, providing government and lake communities more time to respond to threats.



9.13 Control

Once invasive species become established at a lake, they are extremely expensive and time consuming to remove. Most control or management is done by the Government of Saskatchewan, particularly when it comes to invasive fish, mussels, or wildlife. However, lake communities and lake users can assist control efforts by collaborating with government,

municipalities, and non-government organizations on invasive plant pulling events. These events increase the efficiency of invasive plant removal and provide opportunities for residents and lake users to learn from officials on invasive species identification and control.

9.2 SUSTAINABLE HARVEST

Sustainable harvest of fish from a lake is critical for preserving lake health. Overharvest of any species will reduce population size and result in a trophic shift in the aquatic ecosystem. Repeated overharvest will permanently reduce population numbers and extirpate the species from a lake.

Popular species that are harvested include fish such as Walleye, Northern Pike, Yellow Perch, and plants such as Wild Rice. To conserve these species and protect lake health, commercial and recreational harvesters must follow laws and quotas pertaining to harvest. Laws or quotas allow for sustainable harvest but change annually and differ on regional and lake-by-lake scales. Following laws and quotas will ensure harvest is done sustainably.

In addition, recreational anglers should focus on 'limiting their catch' instead of 'catching their limit'. Practicing proper catch and release of fish and changing angler mindsets to only harvesting the number of fish needed instead of all the fish they are legally allowed will help keep fish populations sustainable over time.



9.3 POLLUTION PREVENTION

Pollution from cabins, lake properties, or recreation pose a serious threat to lake health. Pollution comes in many forms including household garbage, yard trimmings, leaking boat engines, and old or deteriorating infrastructure. This can harm fish and wildlife if consumed and degrade water quality as it breaks down and releases toxic chemicals into the water.

To address general pollution, lake users and property owners must be diligent when disposing of garbage, yard trimmings, old equipment, and infrastructure. Any waste should be taken to designated landfills and not dumped in or near a lake. Leaking or damaged boat engines or gas tanks should not be used and instead repaired or decommissioned. Property owners can remove junk like tires, concrete slabs, or metals, and ensure deteriorating infrastructure is removed or repaired by certified parties and not left to break down in the lake. All lake users can work as a team to clean up any garbage on the lake or shoreline such as styrofoam, plastic bags, glass, and cans. Campers, anglers, and boaters should pack out all items on boating and camping trips, leaving the lake and shoreline in pristine condition.



9.4 HABITAT CONSERVATION

Species of fish and wildlife within an aquatic ecosystem rely on lakes for habitat. If lake habitat is destroyed or damaged, then these species do not have anywhere to live so biodiversity and lake health suffers. To keep aquatic ecosystems and lakes healthy, lake habitat needs to be conserved with lake stewardship BMPs.

Many lakes or habitats within lakes are currently preserved by Provincial Parks, National Parks, wilderness areas, Wildlife Habitat Protected Area (WHPA) lands, or bird sanctuaries. Continued conservation of these areas will maintain habitat and preserve lake health. However, governments might consider collaborating with lake property owners or communities to conserve habitat in additional locations on lakes, such as migratory bird stopover locations, breeding grounds, fish spawning or rearing areas, and rare plant zones. Conservation of additional lake habitat beyond what is already protected will improve lake health over the long term.

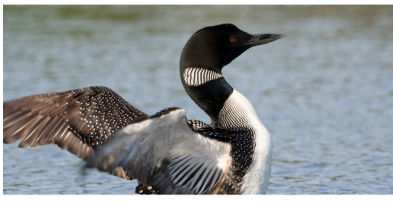
Lake property owners can also do their part to conserve habitat. Wherever possible, property owners should preserve native vegetation on their land and not pull, mow, dredge, cut down, or over prune vegetation. Property owners can protect dead or downed trees and leave natural debris, providing niche habitat for species like woodpeckers and owls. Property owners can also create wildlife habitat in their landscape. Planting native vegetation in a layering effect as groups or thickets to create edges and corridors and building wildlife shelters or nest boxes and placing them in the landscape will provide habitat. Where native shorelines have been replaced with erosion control such as riprap or break walls, property owners can reintroduce native vegetation by planting shrubs, vines, and overhanging plants in pockets between riprap rocks or holes in break walls.

10.0 CONCLUSION

Lakes are critical for life, health, and prosperity in Saskatchewan. However, challenges to water quality, quantity, shorelines, infrastructure, and the aquatic ecosystem continue to threaten the long-term sustainability and health of Saskatchewan lakes, potentially impacting the value of lake property. The Saskatchewan Lake Stewardship Strategy provides solutions for these challenges while simultaneously acting as an educational tool for lake-dependent groups. Using the strategy as a guide, communities can work together to collaboratively implement lake stewardship practices which will help maintain lakes for generations to come. As more lake stewardship BMPs are implemented, more groups and individuals will become knowledgeable of lake stewardship practices, rapidly expanding the adoption of BMPs and increasing the effectiveness of lake stewardship. Through collaboration, education, and communication, lake stewardship is the key to sustaining healthy lakes and rivers in Saskatchewan.



11.0 APPENDIX



For more information on Lake Stewardship Best Management Practices (BMPs) and SAW's Lake Stewardship Strategy visit:

www.saskwatersheds.ca

This project was undertaken with the financial support of
Ce projet a été réalisé avec l'appui financier de



Canada
Water Agency

Agence de l'eau
du Canada



Saskatchewan Association of Watersheds Inc.
300B Diefenbaker Drive
Moose Jaw, Saskatchewan, S6H 0C2
www.saskwatersheds.ca



Lake Stewardship

Promoting Lake Recreation BMPs



LAKE RECREATION STEWARDSHIP AROUND THE LAKE

Recreation such as swimming, boating, fishing, and wildlife watching are staples of Saskatchewan living, and lakes provide these opportunities for thousands of users annually.

However, as our population grows, the demand for lake recreation increases, creating challenges for lake health.

Lake Recreation Stewardship is crucial because water bodies are highly sensitive to pollution and ecosystem changes.

Boating

Unnatural wave action from watercraft can cause bank erosion

Protecting Water Quality

Leaks or spills when fueling watercraft or offloading wastewater can contaminate lakes and reduce water quality.

Fishing

Over-harvest of fish can damage populations or even extirpate the species from a lake.

Preventing Invasive Species

Watercraft can transport aquatic invasive species, potentially causing irreparable damage to water quality, shorelines, ecosystems, and infrastructure.

Preventing Pollution

Pollution from fishing or camping including line, ropes, buoys, plastics, cans, glass, and other general waste can harm wildlife and deteriorate water quality.

HOW CAN LAKE RECREATION STEWARDSHIP SUPPORT HEALTHY LAKES?

Implementing best management practices that reduce our impact on lakes during recreational activities can keep our lakes healthy.

Some key BMPs include:

Boating Responsibly

Keep boat speeds under 10 km/hour when within 15 meters of shore to keep wakes small and limit erosion.

Fueling Responsibly

Refuel or offloading waste from watercraft away from the water and cleaning up any gas, oil, or wastewater spills.

Invasive Species Prevention

Use the clean, drain, dry technique for watercraft and equipment to prevent the spread of harmful aquatic invasive species.



Wildlife Conservation

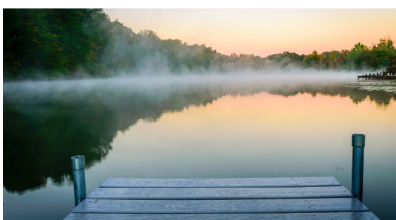
Be a responsible angler that follows fisheries regulations and handles fish with care.

Waste Management

Ensure waste from fishing, camping, and boating trips is not thrown in the lake and is instead packed out and properly disposed.



Where Water, Wellness & Communities Meet



For more information on Lake Stewardship Best Management Practices (BMPs) and SAW's Lake Stewardship Strategy visit:

www.saskwatersheds.ca

This project was undertaken with the financial support of
Ce projet a été réalisé avec l'appui financier de



Saskatchewan Association of Watersheds Inc.
300B Diefenbaker Drive
Moose Jaw, Saskatchewan, S6H 0C2
www.saskwatersheds.ca



Lake Stewardship

Promoting BMPs for Lakefront Ownership



LAKEFRONT OWNERSHIP STEWARDSHIP AROUND THE LAKE

Lakefront property provides exciting opportunities for cabin owners and resort communities to enjoy all that lakes offer. However, as the number of lake property owners and lakeside developments rise, challenges for lake water quality, quantity, shorelines, and aquatic ecosystem become more apparent.

To keep lakes pristine, lake property owners can work as a community to implement best management practices that limit the impact their property has on a lake.

Protecting the Shoreline:
Removal of natural shoreline vegetation and riparian areas when installing infrastructure can destabilize the shoreline and cause erosion, deteriorating water quality.

Protecting Water Quality:
Use of lawn fertilizers can add excess nutrients to the lake, causing more frequent and severe algae blooms.

Safeguarding Drinking Water:
Leaking septic tanks, chemical spills, and applied pesticides or herbicides can run into lakes and contaminate water, putting wildlife and people at risk.

Maintaining a Healthy Ecosystem:
Removing aquatic plants, dredging, and securing infrastructure to the shoreline or lake bottom can damage habitat and disturb trapped nutrients and sediments, deteriorating water quality.

HOW CAN LAKEFRONT OWNER STEWARDSHIP SUPPORT HEALTHY LAKES & RIVERS?

Implementing best management practices that reduce our impact on lakes can keep our lakes healthy.

Some key BMPs include:

Establish Riparian Buffer Zones

Leaving riparian areas and natural vegetation buffers on your property which filter pollutants, nutrients, and sediments.

Restore a Healthy Riparian Zone

Planting native trees and shrubs on your property in places where soil is exposed. This creates habitat and reduces erosion, protecting water quality.

Fertilizer Management

Reducing lawn fertilizer use where possible and avoiding fertilizers that contain phosphorus.

Home Ownership Management

Having your septic system routinely inspected and emptied or repairing and replacing leaking septic systems to prevent lake contamination.

Use Earth-Friendly Products

Opt for environmentally friendly phosphorus-free detergents, cleaners, pesticides, and herbicides that are approved for use near water.



Residential Waste Management

Clean up chemical spills immediately and thoroughly and ensuring household waste, garbage, yard trimmings, old equipment, and damaged infrastructure is properly disposed of in designated landfills.

Infrastructure

Using existing public infrastructure or sharing infrastructure such as docks or marinas instead of installing your own. Opting for lake-friendly infrastructure where possible, such as floating docks or swimming platforms without EPS foam or chemical coatings.



Where Water, Wellness & Communities Meet



For more information on Lake Stewardship Best Management Practices (BMPs) and SAW's Lake Stewardship Strategy visit:

www.saskwatersheds.ca

This project was undertaken with the financial support of
Ce projet a été réalisé avec l'appui financier de



Canada

Agence de l'eau
du Canada

Water Agency



Saskatchewan Association of Watersheds Inc.
300B Diefenbaker Drive
Moose Jaw, Saskatchewan, S6H 0C2
www.saskwatersheds.ca



Saskatchewan
Association
of Watersheds

Lake Stewardship

Promoting Agriculture BMPs



AGRICULTURE STEWARDSHIP AROUND THE LAKE

Agriculture is the backbone of Saskatchewan's economy and identity. With over 60 million of total agriculture acres, Saskatchewan agriculture producers rely on water from our lakes to produce food, mitigate climate extremes and variabilities and provide water supplies such as drinking water and irrigation.

Agriculture stewardship around lakes and rivers is crucial because water bodies are highly sensitive to pollution and ecosystem changes.

Protecting Water Quality: Runoff from agricultural lands can carry nutrients like nitrogen and phosphorus into lakes and rivers, compromising lake water quality.

Maintaining Sustainable Agriculture: Healthy water systems contribute to long-term soil fertility and farm productivity, ensuring future generations can continue farming and ranching.

Preventing Soil Erosion: Increases of sediment runoff from adjacent lands disrupts fish habitats, and interferes with aquatic ecosystems.

Reducing Flood Risks: Well-managed landscapes with natural vegetation absorb and slow down runoff, reducing the risk of flooding and protecting those downstream.

Safeguarding Wildlife: Wetlands and riparian zones (areas near water) provide vital habitats for birds, fish, and other wildlife. Stewardship helps preserve these ecosystems.

HOW CAN AGRICULTURE STEWARDSHIP SUPPORT HEALTHY LAKES & RIVERS?

Agriculture producers can implement Beneficial Management Practices (BMPs) around lakes to protect water quality, enhance soil health, and promote sustainable farming and ranching.

Some key BMPs include:

Establish Riparian Buffer Zones

Establish native vegetative buffers, along lake shores to reduce runoff, filter pollutants, and prevent erosion.

Wetland Conservation

Preserve and restore wetlands near lakes to help filter pollutants and maintain biodiversity. Water Security Agency's Agricultural Stewardship Policy provides guidelines for responsible agriculture water management.

Nitrogen Management

Adopt precision nitrogen application techniques, such as polymer-coated urea and split fertilizer applications and adopt 4R Principles (right source, right time, right place, right rate and , to minimize nutrient runoff into lakes.

Cover Cropping

Seeding cover crops adjacent to lakes and rivers helps maintain soil structure, reduce erosion, and improve water retention.



Rotational Grazing

Utilize rotational grazing systems to minimize overgrazing near water sources, improving pasture health and reducing sediment runoff.

Livestock Water Protection

Invest in off-site livestock watering systems and fencing off riparian areas to prevent direct livestock access to lakes, reducing contamination risks.

Agriculture Waste Management

Follow the guide and regulations under Saskatchewan's Agricultural Operations Act, which ensures that manure management protects water resources and minimizes environmental impact.



Where Water, Wellness & Communities Meet

12.0 GLOSSARY

Algae Bloom – A visible concentration of algae in or around the surface of a lake.

Aquifer – A permeable subsurface zone that holds groundwater.

Bank – The land immediately adjacent to a lake, existing between the bed and boundary.

Bed – The land in which the water in a lake sits.

Conservation Easement – A legal agreement between a property owner and a conservation agency or organization to restrict the type and amount of development on the owner's property.

Contamination – The presence of undesirable elements that render something unsuitable, unfit, or harmful. In the case of lakes, this typically refers to contamination of lake water by unnatural chemicals or bacteria.

Drainage – The natural or artificial removal of surface water from one area to another, typically for the purpose of accessing additional land.

Dredging – Excavating material from an aquatic environment.

Ecosystem – A system formed by a community of organisms that interact with each other and their environment.

Effluent – The liquid waste from treated sewage or industrial processing.

Enhancement – The process of improving an ecosystem to increase its value or health.

Erosion – A physical process where soil, rock, or material from a lake shoreline is removed due to wave action, wind, runoff, or rainfall and transported and deposited elsewhere in a lake.

Eutrophication – The process in which nutrients accumulate in a lake, resulting in increased growth of microorganisms such as algae which can deplete the water of oxygen.

Fill – Earth, sand, gravel, or any other material used to raise, lower, or affect the contours of the ground, shoreline, or lake bottom.

Groundwater – Water that infiltrates through the earth's surface and accumulates underground.

Habitat – The specific component of the environment (aquatic, terrestrial, etc.) upon which a living organism depends on to survive.

Invasive – The ability to spread or infringe. This term identifies species that can take over a given area or entire ecosystem and be detrimental to other species or the environment.

Lakefront – Land existing along or adjacent to a lake.

Leaching – The process where nutrients, chemicals, or contaminants are dissolved and carried away by water into the soil or a lake.

Native Species – A plant or animal that originally occurred in the area.

Non-native – A plant or animal that originated in another region or on another continent.

Remediation – The process of removing dangerous or poisonous substances from the environment or limiting the effect that they have on it.

Reservoir – Man-made lake created by impounding a natural river.

Resort Community – Community existing along, adjacent to, or depending highly on a lake to provide living requirements on a full time or seasonal basis.

Restoration – The process of returning an ecosystem to a state comparable to its original one.

Retaining Wall – A structure designed to restrain shoreline soil to a slope that it would not naturally keep, preventing erosion.

Riparian Area – Land containing moist soils and moisture-loving plants that borders lakes or any other waterbody.

Riprap – Large, loose stone placed on top of filter cloth along the bank of a shoreline for the purpose of reducing or preventing erosion.

Runoff – Rainfall or snowmelt which exceeds the rate at which water can soak into the soil, resulting in water flow over the land surface.

Sedimentation – The process in which sediments enter a lake and become suspended within the water before eventually settling to the lake bottom.

Seepage – The passage of fluid through a barrier.

Slumping – The collapse of land in a landslide, typically due to erosion.

Stewardship – A personal commitment to care for land, water, or any other environmental component by sustaining or enhancing it for the enjoyment of future generations.

Substrate – The material that forms the bed of a lake.

Water Quality – The chemical, physical, and biological characteristics of water.

Watershed – The area of land that drains water into a larger waterbody such as a lake.

Wastewater – Water used or contaminated by various processes or activities.

Holistic – The belief that the parts of something are interconnected.

13.0 LIST OF ACRONYMS

AHPP – Aquatic Habitat Protection Permit

AIS – Aquatic Invasive Species

BMPs – Best Management Practices

DFO – Department of Fisheries and Oceans Canada

EMPA – The Environmental Management and Protection Act

EPO – Environmental Protection Officer

EPP – Environmental Protection Plan

FRWIP – Saskatchewan Ministry of Agriculture Farm and Ranch Water Infrastructure Program

MoE – Saskatchewan Ministry of Environment

RM – Rural Municipality

SAW – Saskatchewan Association of Watersheds

SWEAP – Saskatchewan Watershed Environmental Agriculture Program

WHPA – Wildlife Habitat Protected Area

WSA – Water Security Agency



14.0 LIST OF LEGISLATION & GOVERNING AGENCIES

LEGISLATION	GOVERNING AGENCIES
The Environment Management and Protection Act, 2010	Water Security Agency, Saskatchewan Ministry of Environment
The Shoreland Pollution Control Regulations, 1976	Water Security Agency, Saskatchewan Ministry of Environment
The Provincial Lands Act, 2016	Saskatchewan Ministry of Environment
The Wildlife Habitat Protection Act, 1984	Saskatchewan Ministry of Environment
The Agricultural Operations Act, 1995	Saskatchewan Ministry of Environment
The Wildlife Act, 1998	Saskatchewan Ministry of Environment
The Fisheries Act, 2020	Saskatchewan Ministry of Environment
The Fisheries Regulations, 1995	Saskatchewan Ministry of Environment
Canadian Navigable Waters Act, 2019	Transport Canada
Fisheries Act, 1985	Fisheries and Oceans Canada
The Waterworks and Sewer Works Regulations, 2015	Water Security Agency
Canadian Environmental Protection Act, 1999	Government of Canada Ministry of Environment and Climate Change
Master Agreement on Apportionment, 1969	Government of Saskatchewan - Prairie Provinces Water Board
Boundary Waters Treaty, 1909	International Joint Commission

15.0 ADDITIONAL RESOURCES AND CONTACTS

Ducks Unlimited Canada

Website: <https://www.ducks.ca/places/saskatchewan/>
Phone: 1-800-655-3825

Federation of Sovereign Indigenous Nations

Website: <https://www.fsin.ca/>
Phone: 1-306-655-1215

Fisheries and Oceans Canada

Website: <https://www.dfo-mpo.gc.ca/index-eng.html>
Phone: 204-983-5000

Invasive Species Centre

Website: <https://www.invasivespeciescentre.ca/>
Phone: 1-705-541-5790

Lake Bathymetry

Website: https://www.gpsnauticalcharts.com/main/ca/saskatchewan_fishing_maps-saskatchewan-fishing-maps-nautical-charts-folio.html

Ministry of Environment, Government of Saskatchewan

Website: <https://www.saskatchewan.ca/government/government-structure/ministries/environment>
Phone: 1-800-567-4224

Ministry of Environment, Government of Saskatchewan – Healthy Beaches Program

Website: <https://www.saskatchewan.ca/residents/environment-public-health-and-safety/environmental-health/healthy-beach-program>

Ministry of Agriculture, Government of Saskatchewan

Website: <https://www.saskatchewan.ca/government/government-structure/ministries/agriculture>
Phone: 1-866-457-2377

Ministry of Agriculture, Government of Saskatchewan – Regulation of Agricultural Operations

Website: <https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/livestock/livestock-and-the-environment/regulation-of-intensive-livestock-operations-in-saskatchewan>
Phone: 1-306-787-2150

Nature Conservancy of Canada

Website: <https://www.natureconservancy.ca/en/>
Phone: 1-877-231-3552

Nature Saskatchewan

Website: <https://naturesask.ca/>
Phone: 1-800-667-4668

Provincial Association of Resort Communities

Website: <https://www.skparcs.com/>
Phone: 1-306-531-9466

Provincial Spill Control Centre

Phone: 1-800-667-7525

Saskatchewan Association of Watersheds

Website: <https://saskwatersheds.ca/>
Phone: 1-306-541-9902

Saskatchewan Conservation Data Center

Website: <https://biodiversity.sk.ca>

Saskatchewan Health Authority

Website: <https://www.saskhealthauthority.ca/>
Phone: 1-306-655-0080 or (911) in case of emergency

Saskatchewan Wildlife Federation

Website: <https://swf.sk.ca/>
Phone: 1-306-692-8812

T.I.P.P. (Turn in Poachers and Polluters)

Phone: 1-800-667-7561

Water Security Agency

Website: <https://www.wsask.ca/>
Phone: 1-866-727-5420

Water Security Agency – Aquatic Habitat Protection

Website: <https://www.wsask.ca/water-programs/aquatic-habitat-protection/>
Phone: 1-866-727-5420

Watersheds Canada

Website: <https://watersheds.ca/>
Phone: 1-613-264-1244



16.0 LITERATURE CITED

- Alberta Association of Summer Villages. 2008. Lake Stewardship Guide. Available at: <http://www.albertasummervillages.org/summer-villages/lake-stewardship/lake-stewardship-guide>
- Bos, J. S., Nanayakkara, L., Hurlbert, M., & Finlay, K. (2019). Citizen science for Saskatchewan lakes: a pilot project. *Lake and Reservoir Management*, 35(1), 77-89. <https://doi.org/10.1080/10402381.2018.1538172>
- Buffalo Lake Integrated Shoreline Management Plan. 2010. Government of Alberta. Available at: <http://blmt.ca/wp-content/uploads/2011/05/BLIMPS-Book-May11-2011.pdf>
- Canadian Navigable Waters Act, 2019. <https://laws-lois.justice.gc.ca/eng/acts/n-22/>
- Carothers, S.W. (1977). Importance, Preservation, and Management of Riparian Habitats: An Overview. In *Importance, Preservation and Management of Riparian Habitat: A Symposium*, USDA Forest Service, General Technical Report RM-43, Tucson, AZ., 1977, pp. 2 - 4. Retrieved from: https://www.fs.usda.gov/rm/pubs_rm/rm_gtr043.pdf.
- Chislock, M. F., Doster, E., Zitomer, R. A. & Wilson, A. E. (2013) Eutrophication: Causes, Consequences, and Controls in Aquatic Ecosystems. *Nature Education Knowledge* 4(4):10.
- Coyle, D. (2022). Guide to Preparing a Shoreline Naturalization Planting Plan. (Watersheds Canada). Retrieved from: <https://watersheds.ca/planning-for-our-shorelands>
- Dabney, S.M. (2008). Erosion Control: Vegetative. In S.W. Timble (Ed.), *Encyclopedia of Water Science* (272 - 276). CRC Press, Taylor & Francis Group. ISBN: 13: 978-0-8493-9627-4.
- Dennison, C. (2022). The Science Behind Vegetated Shoreland Buffers: Why the Ribbon of Life Matters. Edited by Darlene Coyle. (Watersheds Canada). Retrieved from: <https://watersheds.ca/planning-for-our-shorelands>
- Dennison, C. (2020). The Future of Our Shores: A Report on three stakeholder surveys. (Watersheds Canada).
- Dodds, W.K., Bouska, W.W., Eitzmann, J.L., Pilger, T.J., Pitts, K.L., Riley, A.J., Schloesser, J.T., & Thornbrugh, D.J. (2009). Eutrophication of U.S. Freshwaters: Analysis of Potential Economic Damages. *Environmental Science & Technology*, 43(1), 12 - 19. <https://doi.org/10.1021/es801217q>.
- Environment and Climate Change Canada (ECCC). (2017). Water quality issue: nutrients. Government of Canada. Retrieved from: <https://www.canada.ca/en/environment-climate-change/services/freshwater-qualitymonitoring/nutrients-aquatic-ecosystems.html>.
- Federation of Ontario Cottagers' Associations (FOCA). (2015). A Shoreline Owner's Guide to Healthy Waterfronts. https://foca.on.ca/wp-content/uploads/Shoreline_Owners_Guide_2015/files/index/html
- Fisheries and Oceans Canada. (2008). The Dock Primer: A cottager's guide to waterfront-friendly docks. DFO/2008-1430, 2008. https://www.lwcb.ca/beforeyoubuild/dock-quias-on_e.pdf
- Fisheries and Oceans Canada. (1992). Land Development Guidelines for the Protection of Aquatic Habitat. https://www.bclss.org/wp-content/uploads/2017/05/LandDevelopmentGuidelines_Protection_Aquatic_Habitat.pdf
- France, R.L. (1997). Potential for soil erosion from decreased litterfall due to riparian clearcutting: Implications for boreal forestry and warm- and cool-water fisheries. *Journal of Soil and Water Conservation*, 52(6), 452 - 455. Online ISSN: 1941-3300.
- Fisheries Act, RSC 1985. c F-14, <https://canlii.ca/t/543j4>
- Garrison, P.J., LaLiberte, G.D., & Ewart, B.P. (2010). The importance of water level changes and shoreline development in the eutrophication of a shallow, seepage lake. *Proceeding of the Academy of Natural Sciences of Philadelphia*, 160, 113 - 126.
- Government of Alberta, Ministry of Environment and Parks (2020). Respect our lakes: responsible lake living. Fact sheet, pg 1-2. <https://open.alberta.ca/dataset/41c8b9b5-7379-483d-bbd4-17e66fcf215c/resource/d44bdcd2-c6d9-4ede-a05b-440b5397357e/download/epa-respect-our-lakes-responsible-lake-living-2023-08.pdf>
- Government of Alberta, Ministry of Environment and Parks (2020). Respect our lakes: agriculture around Alberta lakes. Fact sheet, pg 1-2. <https://open.alberta.ca/publications/respect-our-lakes-agriculture-around-alberta-lakes>
- Government of Alberta, Ministry of Environment and Parks (2020). Respect our lakes: responsible lake recreation. Fact sheet, pg 1-2. <https://open.alberta.ca/dataset/095632a2-d0b6-441f-8940-90553403200d/resource/388147cf-fcc4-4aeb-b332-dc6012a73f03/download/epa-respect-our-lakes-responsible-lake-recreation-2023-08.pdf>
- Government of Alberta, Ministry of Environment and Parks (2020). Respect our lakes: lake legislation in Alberta. Fact sheet, pg 1-2. <https://open.alberta.ca/dataset/877a0483-f4f2-43b0-89e9-273d60fcc5a8/resource/c13fe1a5-699d-4ee3-ac0a-de681e46ef66/download/epa-respect-our-lakes-lake-legislation-infographic-2023-08.pdf>
- Government of Alberta, Ministry of Environment and Parks (2020). Respect our lakes: aquatic vegetation and lake health. Fact sheet, pg 1-2. <https://open.alberta.ca/publications/9781460122525>
- Government of Alberta, Ministry of Environment and Parks (2020). Respect our lakes: cyanobacteria (blue-green algae). Fact sheet, pg 1-2. <https://open.alberta.ca/publications/respect-our-lakes-blue-green-algae-cyanobacteria>

- Government of Alberta, Ministry of Environment and Parks (2020). Respect our lakes: understanding lake science. Fact sheet, pg 1-2. <https://open.alberta.ca/publications/9781460122501>
- Government of Alberta, Ministry of Environment. (2015). Spring run-off flood prevention. Fact sheet, pg 1-2. <https://open.alberta.ca/dataset/spring-run-off-flood-prevention#detailed>
- Government of Alberta, Ministry of Environment and Parks. (2020). Public Lands Act and Water Act: shoreline/water body modifications. Face sheet, pg 1-2. <https://open.alberta.ca/publications/public-lands-act-and-water-act-shoreline-water-body-modifications-facts-at-your-fingertips/resource/923d9775-5e66-4213-90d3-d9dede21ec64>
- Government of Alberta. (2010). Facts about water in Alberta. <https://open.alberta.ca/publications/9780778589709#summary>
- Government of Alberta, Ministry of Environment and Sustainable Resource Development. (2012). Stepping Back from the Water: a beneficial management practices guide for new development near water bodies in Alberta's settled region. <https://open.alberta.ca/publications/9781460100592>
- Government of Alberta, Municipal Affairs, Alberta Safety Codes Council. (2012). Safety tips: private sewage treatment systems. <https://open.alberta.ca/publications/9780778571278#detailed>
- Government of Saskatchewan, (2022). Framework for the Prevention and Management of Invasive Species in Saskatchewan. <https://www.saskatchewan.ca/residents/environment-public-health-and-safety/wildlife-issues/invasive-species>
- Government of Saskatchewan, Ministry of Agriculture. (2024). Regulation of Intensive Livestock Operations in Saskatchewan. <https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/livestock/livestock-and-the-environment/regulation-of-intensive-livestock-operations-in-saskatchewan>
- Government of Saskatchewan. (2024). Manure Spills. <https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/livestock/livestock-and-the-environment/manure-spills>
- Graziano, M. P., Deguire, A. K., & Surasinghe, T. D. (2022). Riparian Buffers as a Critical Landscape Feature: Insights for Riverscape Conservation and Policy Renovations. *Diversity*, 14(3), 172. <https://doi.org/10.3390/d14030172>.
- Hecker, M., Khim, J. S., Giesy, J. P., Li, S. Q., & Ryu, J. H. (2012). Seasonal dynamics of nutrient loading and chlorophyll a in a northern prairies reservoir, Saskatchewan, Canada. *Journal of Water Resource and Protection*, 4(04), 180.
- Hewlett, C., North, R. L., Johansson, J., Vandergucht, D. M., & Hudson, J. J. (2015). Contribution of shoreline erosion to nutrient loading of the Lake Diefenbaker reservoir, Saskatchewan, Canada. *Journal of Great Lakes Research*, 41, 110–117. <https://doi.org/10.1016/j.jglr.2014.11.020>.
- Hilborn, E.D. & Beasley, V.R. (2015). One Health and Cyanobacteria in Freshwater Systems: Animal Illnesses and Deaths Are Sentinel Events for Human Health Risks. *Toxins*, 7(4), 1374 – 1395. <https://doi.org/10.3390/toxins7041374>.
- Hosseini, N., Johnston, J., & Lindenschmidt, K. E. (2017). Impacts of climate change on the water quality of a regulated prairie river. *Water*, 9(3), 199.
- Howell, E. T., Chomicki, K. M., & Kaltenecker, G. (2012). Patterns in water quality on Canadian shores of Lake Ontario: Correspondence with proximity to land and level of urbanization. *Journal of Great Lakes Research*, 38, 32–46. <https://doi.org/10.1016/j.jglr.2011.12.005>.
- Jaakson, R., Buszynski, M. D., & Botting, D. (1976). Carrying capacity and lake recreation planning: A case study from North-Central Saskatchewan, Canada. *Town Planning Review*, 47(4), 359.
- Kehrig, R. F. (2002). Agricultural practices and water quality in Saskatchewan: The social ecology of resource management (Doctoral dissertation, University of Saskatchewan).
- Kipp, S.L. & Callaway, C. (2003). On the Living Edge: Your Handbook for Waterfront Living, Saskatchewan/Manitoba Edition. The Federation of British Columbia Naturalists, Nature Saskatchewan. ISBN: 0-91104-17-0
- Mankin, K. R., Ngandu, D. M., Barden, C. J., Hutchinson, S. L., & Geyer, W. A. (2007). Grass-Shrub Riparian Buffer Removal of Sediment, Phosphorus, and Nitrogen From Simulated Runoff. *JAWRA Journal of the American Water Resources Association*, 43(5), 1108–1116. <https://doi.org/10.1111/j.1752-1688.2007.00090.x>.
- Mickle, A.M. (1993). Pollution Filtration by Plants in Wetland-Littoral Zones. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 144, 282 – 290.
- Miller, J.K., Rella, A., Williams, A., & Sproule, E. (2015). Living Shoreline Engineering Guidelines. Hoboken, New Jersey: Stevens Institute of Technology, Davidson Laboratory, Center for Maritime Systems, 101p.
- Moose Lake Watershed Management Plan. 2007. Aquality Environmental Consulting. Prepared for: Moose Lake Water For Life Committee. Available at: http://md.bonnyville.ab.ca/downloads/residents/mooselake_watershed/mngmt_plan_apr30_2007.pdf
- Naiman, R.J., Decamps, H., & Pollock, M. (1993). The Role of Riparian Corridors in Maintaining Regional Biodiversity. *Ecological Applications*, 3(2), 209 – 212. <https://www.jstor.org/stable/1941822>.
- Narayan, S., Beck, M.W., Reguero, B.G., Losada, I.J., van Wesenbeeck, B., Pontee, N., Sanchirico, J.N., Ingram, J.C., Lange, G.M., & Burks-Copes, K.A. (2016). The Effectiveness, Costs and Coastal Protection Benefits of Natural and Nature-Based Defences. *PLoS One*, 11(5): e015735. doi: 10.1371/journal.pone.0154735.
- Osbourne, L.L. & Kovacic, D.A. (1993). Riparian vegetated buffer strips in water quality restoration and stream management. *Freshwater Biology*, 29(2): 243 – 258. <https://doi.org/10.1111/j.1365-2427.1993.tb00761.x>.

- Penn, B. (1996). Stewardship Options for Private Landowners in British Columbia. Province of British Columbia, Ministry of Environment, Lands, and Parks. <https://www.bclss.org/wp-content/uploads/2017/05/StewardshipOptions-4PrivateLandownersBC.pdf>
- Pick, F. (2016). Blooming algae: a Canadian perspective on the rise of toxic cyanobacteria. *Canadian Journal of Fisheries and Aquatic Sciences*, 73(7), 1149–1158. <https://doi.org/10.1139/cjfas-2015-0470>.
- Pomeroy, J., Fang, X., & Williams, B. (2009). Impacts of climate change on Saskatchewan's water resources. Centre for Hydrology, University Saskatchewan, Saskatoon, Saskatchewan.
- Prairie Provinces Water Board (2009). Master Agreement on Apportionment and By-laws, Rules and Procedures, 1969. Regina, Sask.
- Prosser, R. S., Hoekstra, P. F., Gene, S., Truman, C., White, M., & Hanson, M. L. (2020). A review of the effectiveness of vegetated buffers to mitigate pesticide and nutrient transport into surface waters from agricultural areas. *Journal of Environmental Management*, 261(Complete). <https://doi.org/10.1016/j.jenvman.2020.110210>.
- Puschner, B. (2018). Cyanobacterial (Blue-Green Algae) Toxins. In R.C. Gupta (Ed.), *Veterinary Toxicology: Basic and Clinical Principles* (3rd Ed.) (pp. 763–777). Academic Press. DOI: <https://doi.org/10.1016/C2016-0-01687-X>.
- Radomski, P. & Goeman, T.J. (2001). Consequences Of Human Lakeshore Development on Emergent and Floating-Leaf Vegetation Abundance. *North American Journal of Fisheries Management*, 21, 46–61.
- Riis, T., Kelly-Quinn, M., Aguiar, F.C., Manolaki, P., Bruno, D., Bejarano, M.D., Clerici, N., Fernandes, M.R., Franco, J.C., Pettit, N., Portela, A.P., Tammeorg, O., Tammeorg, P., Rodríguez-González, P.M., & Dufour, S. (2020). Global Overview of Ecosystem Services Provided by Riparian Vegetation, *BioScience*, 70(6), 501–514. <https://doi.org/10.1093/biosci/biaa041>.
- Safak, L., Angelini, C., Norby, P.L., Dix, N., Roddenberry, A., Herbert, D., Astrom, E., & Sheremet, A. (2020). Wave transmission through living shorelines breakwalls. *Continental Shelf Research*, 311, 104268. <https://doi.org/10.1016/j.csr.2020.104268>.
- Seavy, N.E., Gardali, T., Golet, G.H., Griggs, F.T., Howell, C.A., Kelsey, R., Small, S.L., Viers, J.H., & Wigand, J.F. (2009). Why Climate Change Makes Riparian Restoration More Important Than Ever: Recommendations for Practice and Research. *Ecological Restoration*, 27(3), 330–338. DOI: 10.3368/er.27.3.330.
- Seddon, N., Chausson, A., Berry, P., Girardin, C.A.J., Smith, A., & Turner, B. (2020). Understanding the value and limits of nature-based solutions to climate change and other global challenges. *Philosophical Transactions B*, 375: 20190120. <http://dx.doi.org/10.1098/rstb.2019.0120>.
- Shoreland Pollution Control Regulations, 1976. Sask Reg 54/76, <https://canlii.ca/t/1szk>
- Smith, E. D., Balika, D., & Kirkwood, A. E. (2021). Community science-based monitoring reveals the role of land use scale in driving nearshore water quality in a large, shallow, Canadian lake. *Lake and Reservoir Management*, 37(4), 431–444. <https://doi.org/10.1080/10402381.2021.1989525>.
- Smith, R.B., Bass, B., Sawyer, D., Depew, D., & Watson, S.B. (2019). Estimating the economic costs of algal blooms in the Canadian Lake Erie Basin. *Harmful Algae*, 87,101624. <https://doi.org/10.1016/j.hal.2019.101624>.
- The Agricultural Operations Act, SS 1995, c A-12.1, <https://canlii.ca/t/536sh>
- The Cities Act, SS 2002. c C-11.1, <https://canlii.ca/t/538kz>
- The Environmental Management and Protection Act, 2010. SS 2010, c E-10.22, <https://canlii.ca/t/56bl3>
- The Fisheries Act, SS 2020. c 23, <https://canlii.ca/t/56bkz>
- The Fisheries Regulations, 1995. <https://laws-lois.justice.gc.ca/eng/regulations/SOR-95-233/page-1.html>
- The Municipalities Act, SS 2005. c M-36.1, <https://canlii.ca/t/56dvz>
- The Provincial Lands Act, 2016. SS 2016, c P-31.1, <https://canlii.ca/t/56931>
- The Wildlife Act, 1998. SS 1998, c W-13.12, <https://canlii.ca/t/5578x>
- The Wildlife Habitat Protection Act, SS 1983-84. c W-13.2, <https://canlii.ca/t/53gr0>
- Tsai, Y., Zabronsky, H. M., Zia, A., & Beckage, B. (2022). Efficacy of Riparian Buffers in Phosphorus Removal: A Meta-Analysis. *Frontiers in Water*, 4. <https://www.frontiersin.org/articles/10.3389/frwa.2022.882560>.
- Vought, L. B.-M., Dahl, J., Pedersen, C. L., & Lacoursière, J. O. (1994). Nutrient Retention in Riparian Ecotones. *Ambio*, 23(6), 342–348.
- Water Security Agency, (2024). Overview of Stream Flows & Lake Levels, Dams & Reservoirs, Provincial Forecast. <https://wsask.ca/recreation-environment/lakes-and-rivers-overview/stream-flows-and-lake-levels/>
- Water Security Agency, (2024). Shoreline Development and Dedicated Lands. <https://wsask.ca/recreation-environment/aquatic-habitat-protection/>
- Watersheds Canada (2021). Love Your Lake 2013-2021 values survey report. Retrieved from: <https://watersheds.ca/love-your-lake>.
- Woolway, R.I., Sharma, S., & Smol, J.P. (2022). Lakes in Hot Water: The Impacts of a Changing Climate on Aquatic Ecosystems. *BioScience*, biac052. <https://doi.org/10.1093/biosci/biac052>.
- Zhang, Z. (2015). Assessing the Current Threat of Aquatic Invasive Species in Saskatchewan (Doctoral dissertation, University of Saskatchewan Saskatoon).





SAW

Saskatchewan
Association
of Watersheds

For further information on SAW programming,
visit our website at saskwatersheds.ca, email us at
info@saskwatersheds.ca, or call **306-541-9902**.