Water Resources Situational Analysis

Serpent River Watershed, Ontario, Canada

JUNE 2025

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Acknowledgements

We respectfully acknowledge that this work is carried out on the traditional territory of the Anishinaabe people, located within the Robinson-Huron Treaty lands in the Elliot Lake area. In particular, we recognize the Serpent River First Nation as the primary group in the Serpent River Watershed region, along with Missisauga First Nation and Sagamok Anishnawbek, all of whom have maintained a deep and enduring connection to the land, waters, and culture. We honor their stewardship of these lands and pay our respects to their Elders, past, present, and emerging.

We would also like to extend our gratitude to all the participants in the engagement process, including Sagamok Anishnawbek, ELNOS, Elliot Lake Retirement Living, Penokean Hills Field Naturalists, BHP, Mamaweswen, North Shore Tribal Council and Bimaadzwin, whose valuable contributions and insights have significantly enriched the project.

This project was carried out by CONATI, with a multidisciplinary team comprising specialists in water management, environmental sciences, sociology, geography, and other relevant fields. Additionally, we were supported by consultants with expertise in engagement, science communication, and project management.

A Water Resources Situational Analysis (WRSA) is a methodology that provides a general and holistic assessment of water resources for a determined geographical extension. Through a revision of existing public information and local actors' input, it focuses on and identifies shared water challenges, their root cause, shared vision and collective action opportunities.

The report was prepared with funding support from BHP, in the context of its vision for a 'water secure' world by 2030, an aim consistent with the United Nations Sustainable Development Goals. A world where water resources are conserved, and their resilience protected so they can continue to support healthy ecosystems, maintain cultural and spiritual values, and sustain economic growth.

The aim of sharing the results of the WRSA is to stimulate opportunities for coordinated collective action on water, by helping build a common understanding of the shared water challenges and stakeholder priorities with other water users.

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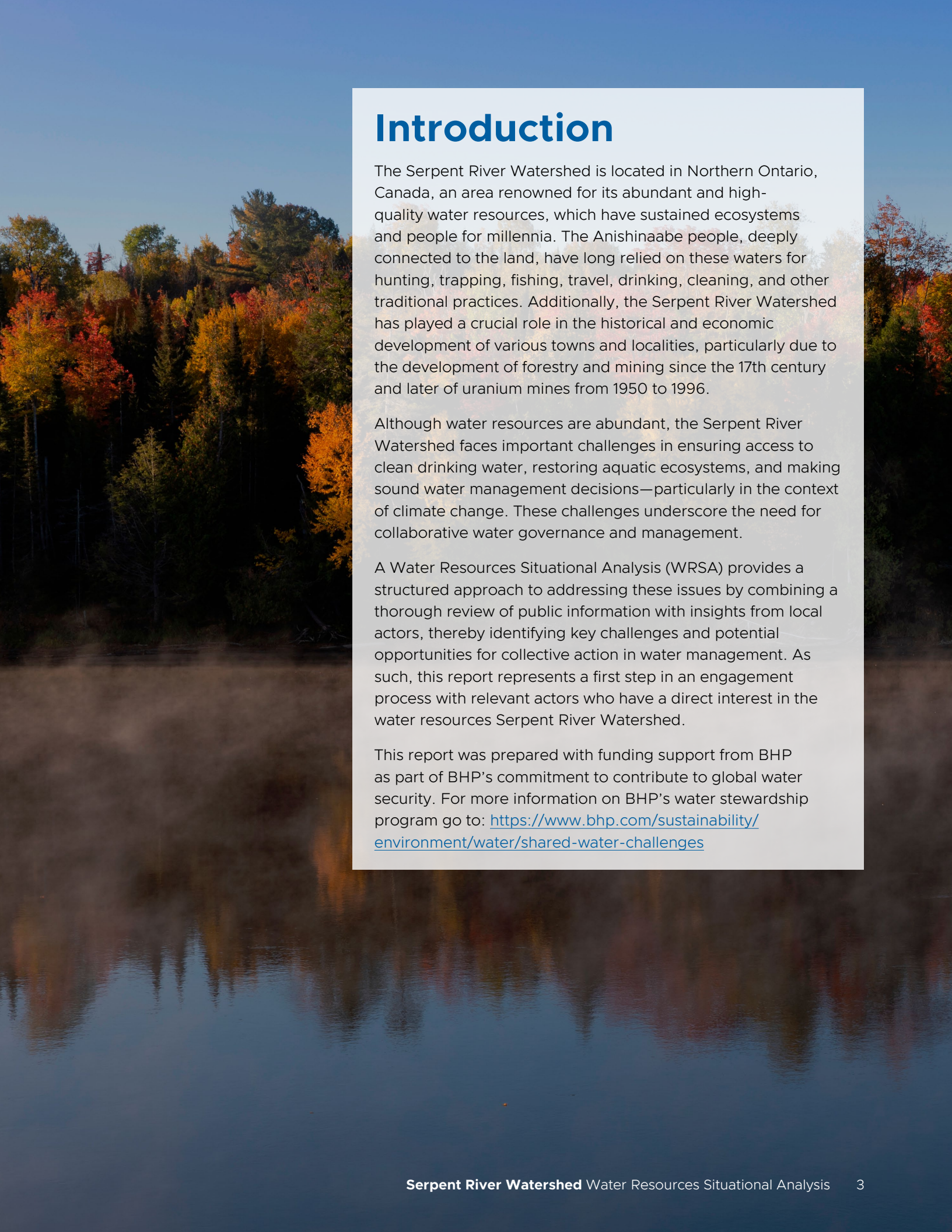


Introduction

The Serpent River Watershed is located in Northern Ontario, Canada, an area renowned for its abundant and high-quality water resources, which have sustained ecosystems and people for millennia. The Anishinaabe people, deeply connected to the land, have long relied on these waters for hunting, trapping, fishing, travel, drinking, cleaning, and other traditional practices. Additionally, the Serpent River Watershed has played a crucial role in the historical and economic development of various towns and localities, particularly due to the development of forestry and mining since the 17th century and later of uranium mines from 1950 to 1996.

Although water resources are abundant, the Serpent River Watershed faces important challenges in ensuring access to clean drinking water, restoring aquatic ecosystems, and making sound water management decisions—particularly in the context of climate change. These challenges underscore the need for collaborative water governance and management.

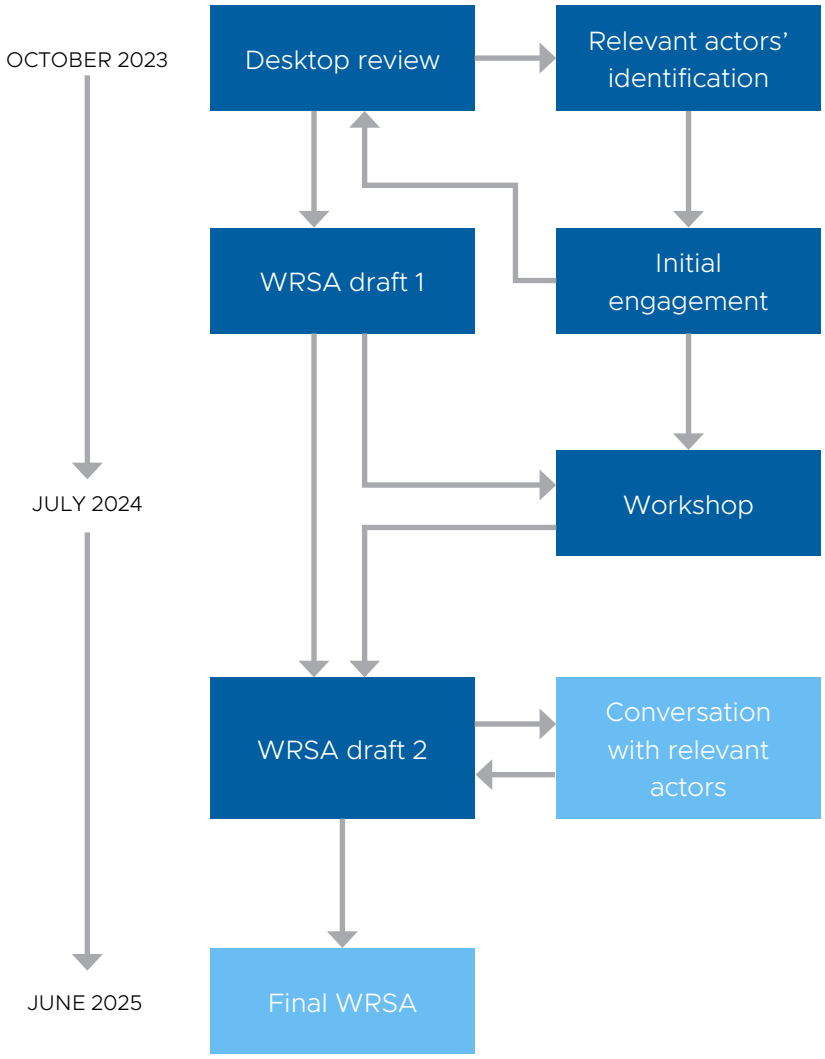
A Water Resources Situational Analysis (WRSA) provides a structured approach to addressing these issues by combining a thorough review of public information with insights from local actors, thereby identifying key challenges and potential opportunities for collective action in water management. As such, this report represents a first step in an engagement process with relevant actors who have a direct interest in the water resources Serpent River Watershed.

This report was prepared with funding support from BHP as part of BHP's commitment to contribute to global water security. For more information on BHP's water stewardship program go to: https://www.bhp.com/sustainability/environment/water/shared-water-challenges

What is a Water Resources Situational Analysis?

A Water Resources Situational Analysis (WRSA) is a comprehensive assessment and synthesis of multiple aspects of water resources, aimed at identifying shared water challenges, their underlying causes, a collective vision (desired conditions), and potential opportunities for collaborative action. The development of the WRSA document involves a thorough desktop review of available information, complemented by interviews and/or workshops with relevant actors. This analysis serves as an initial step in a longer-term process focused on enhancing water stewardship in the study area through continuous dialogue with relevant actors.

WRSA development process



Overview of the Serpent River Watershed

The Serpent River Watershed is in the Algoma region of northern Ontario, Canada. It is bordered by the Lower Mississagi Watershed to the west and north, and by the Spanish Watershed to the east. All three watersheds are part of the Great Lakes system, which includes lakes Superior, Huron, Michigan, Erie and Ontario, and corresponds to a large, interconnected network of water bodies exhibiting considerable variability in groundwater and surface runoff contributions. It serves as a vital lifeline for communities, supports diverse ecosystems, enables economic activities, and provides drinking water to millions of inhabitants.

Geologically, the Serpent River Watershed is situated within the Canadian Shield, featuring rugged terrain with rocky outcrops, dense forests, and numerous lakes and wetlands. It comprises a network of rivers, with the Serpent River being the primary watercourse, playing a crucial role in the overall drainage of the watershed. The Serpent River flows southeastward, eventually draining into the North Channel of Lake Huron. The area experiences long, cold winters and short, warm summers.

The Serpent River Watershed lies within a historically significant Anishinaabe region along the Lake Huron shoreline. The Anishinaabe people are deeply connected to this land and water through traditional practices such as hunting, fishing, and spiritual activities. This area includes two First Nation communities—Serpent River and Mississauga—and is adjacent to the Sagamok Anishnawbek. These communities have faced unique challenges related to the encroachment of European settlers and the subsequent development of industries like logging and mining. The Robinson Huron Treaty of 1850 between the Anishinaabe people and the British government ensured an area where Indigenous peoples could continue to live as they had traditionally, with guaranteed unrestricted access to hunting and fishing.

During the mid-20th century, resource extraction significantly increased, often without proper consultation with Indigenous communities. The Serpent River Watershed, once central to uranium mining operations, experienced environmental contamination that disrupted traditional Anishinaabe practices. Since the 1990s, there has been a growing call for accountability from international corporations and governments concerning the use of Indigenous lands and resources. This shift is driven by a heightened recognition of Indigenous rights and the importance of restitution.

Within the watershed, twelve decommissioned mining operations are situated in the Elliot Lake area, and all but one of their associated Tailings Management Areas (TMAs) discharge into the Serpent River Watershed. Additionally, the watershed is home to a limestone open-pit mine and a copper exploration project.

Environmental features of the Serpent River Watershed

The Serpent River Watershed is part of the Great Lakes–St. Lawrence forest region, which is predominantly composed of hardwood species, including maple, oak, yellow birch, and both white and red pine. Coniferous trees, such as white pine, red pine, hemlock, and white cedar, frequently intermingle with deciduous broad-leaved species.

It also supports a diverse array of wildlife, including predators such as black bears and wolves, large ungulates like white-tailed deer and moose, and numerous small mammals, including beavers, muskrats, and otters. It is also home to bird species such as pileated woodpeckers and various migratory birds.

	Yearly average rainfall (1970-2020)	Yearly average snowfall (1970-2020)	Highest historical monthly average temperature (2000-2024)	Lowest historical monthly average temperature (2000-2024)
Elliot Lake:	**1,137mm**	**271cm**	**29°C**	**-39°C**
Blind River:	**798mm**	**201cm**	**31°C**	**-35°C**
Serpent River:	**775mm**	**N/A**	**31°C**	**-35°C**

Climate projections suggest that the region will experience substantial warming, characterized by an increase in extreme hot days and a reduction in extreme cold days. Annual precipitation is expected to rise, accompanied by more intense rainfall events and a seasonal shift toward increased rain rather than snow during the winter months.

Drainage area

2,700km²

The topography of the watershed is characterized by a lack of high mountains, with elevations reaching up to 400-430 above sea level meters in the northern part of the watershed.

Provincial Parks

Blind River	Matinenda
5,402 hectares	**28,758** hectares

Water bodies

Horne Lake: a relevant waterbody in Elliot Lake, renowned for its scenic surroundings and recreational opportunities. Its shores feature residential land uses — including houses, vacation cottages, hotels, and retirement communities.

Serpent Lake: an important water body that serves as a central feature of the hydrological network.

Elliot Lake: centrally located in a region with over 4,000 lakes, Elliot Lake serves as a key reservoir that regulates water flow and supports groundwater recharge, maintaining local aquatic ecosystems, and serving as a source of drinking water for nearby communities. Its shoreline is developed with houses, lodges, and vacation beaches.

Quirke Lake: historically impacted by mining activities and related discharges, Quirke Lake plays a role in regulating local water quality and flow while contributing to ecological stability and groundwater recharge in the surrounding region. It features residential development along its southern shore.

Dunlop Lake: regulates water flow and contributes to groundwater recharge, while also providing habitats for aquatic life and recreational opportunities like paddling and fishing. Its shores host residential developments including houses and hotels.

Smaller lakes and wetlands: ponds, marshes, and swamps that contribute to ecological diversity.

People and economy of the Serpent River Watershed

The Serpent River Watershed is distinguished by a rich Indigenous heritage, with communities deeply connected to the land and waterways through traditional practices such as hunting, fishing, and cultural ceremonies. The region also includes diverse urban areas, with the City of Elliot Lake being the largest and most prominent.

The region's natural beauty, including its rivers, lakes, and forests, attracts tourists for recreational activities such as fishing, boating, and hiking, which in turn support local businesses and services. Additionally, the area is noted for its retirement living services, which are an important economic sector. Although uranium mining has ceased, the management of decommissioned Tailings Management Areas (TMAs) continues to influence both the local economy and the environment.

Traditional territory of Indigenous Communities

Mississauga First Nation

Their traditional territory extends into the Lake Huron Watershed. The reserve is located at the mouth of Mississaugi River (18,040 hectares).

Total population (2021)

1,521

Living on reserve	Living outside
392	1,129

Serpent River First Nation

Their traditional territory covers the area surrounding the Serpent River Watershed, extending into the islands of the North Channel of Lake Huron. The reserve is located midway between Sault Ste. Marie and Sudbury along the North Channel of Lake Huron. (8,049 hectares).

Total population (2021)

1,633

Living on reserve	Living outside
376	1,257

Sagamok Anishnawbek

Their traditional territory includes the Sagamok Reserve and the surrounding area along Lake Huron and the Spanish River. The reserve is located on the north shore of Lake Huron, south and east of the Spanish River (10,149 hectares).

Total population (2021)

3,350

Living on reserve	Living outside
1,643	1,707

Main urban areas

Elliot Lake (2024)
11,768 residents

Blind River (2021)
3,422 residents

Town of Spanish (2021)
670 residents

Township of The North Shore (2021)
531 residents

- Watershed Boundaries
- Study area
- Indigenous Communities' Legislative Areas
- Urban Areas
- Provincial Parks
- Mining Sites
- Decommissioned Mine Sites
- Exploration Activity Mines

Water challenges and collective actions

Despite Ontario's reputation for water abundance, particularly due to the Great Lakes holding 20% of the world's freshwater, the province faces emerging water challenges. These include limited access to safe drinking water for Indigenous communities, declining recharge rates in the Great Lakes, climate-induced low flows, groundwater depletion, deteriorating water quality, and conflicts among water users. Sectors such as agriculture, municipal utilities, power production, and recreation, which rely on shared water resources, are particularly vulnerable to these risks. This highlights the urgent need for collaborative water governance and sustainable management.

The Serpent River Watershed, affected by some of these challenges, is undergoing a socioeconomic transition. Once a uranium mining hub, it is now evolving into a center for recreation, retirement living, and environmental research. These activities depend on a sustainable water supply that balances extraction with natural replenishment and ensures that water disposal does not compromise quality. To support long-term sustainability, water systems must protect ecosystems while remaining affordable, equitable, and accessible.

The water challenges in the Serpent River Watershed can be grouped into three key areas: securing clean water, protecting aquatic ecosystems, and making sound water-related decisions. Addressing these issues requires participatory governance and coordinated efforts among First Nations and stakeholders.

This report outlines a series of challenges, their underlying causes, and corresponding proposed collective actions. These were first identified through a review of public information and later refined during a workshop with local actors and discussions with representatives from the City of Elliot Lake and First Nations. This collaborative process helps ensure the identified challenges and proposed actions align with both local concerns and practical needs.

To aid in understanding, the identified collective actions have been grouped into five categories:

Collective Action categories

Collaboration and Engagement

Monitoring, Science and Technology

Environmental Protection and Stewardship

Regulatory Compliance and Planning

Education and Awareness

A. Securing clean water

CHALLENGE A1: Securing safe drinking water conditions and sanitation for First Nations and Rural Communities

A significant challenge in the Serpent River Watershed is the persistent lack of investment in drinking water and sanitation infrastructure for First Nations communities, which poses serious health risks. Residents living on reserves and in rural areas often face inadequate training and resources for maintaining this infrastructure. Additionally, there is growing concern regarding insufficient protection of water sources.

Causes

- **Technical Capacity:** lack of local expertise to operate water infrastructure.
- **Source Water Protection:** insufficient protection of water sources.
- **Community Involvement:** limited involvement of First Nations communities in decision-making.
- **Water Resource Vulnerability:** susceptibility of water resources to contamination and depletion.

Collective actions	Category
A1.1 Incorporate Indigenous Knowledge: facilitate participatory opportunities where First Nations members can share insights and expertise on water management practices.	
A1.2 Promote Collaboration: foster cooperation agreements between all levels of government and First Nations to tackle water insecurity, including clear roles, shared responsibilities, and funding commitments to improve drinking water and sanitation infrastructure.	
A1.3 Establish Advisory Committees: create environmental advisory groups within First Nations communities to monitor industrial activity, infrastructure projects and other developments.	
A1.4 Enhance Monitoring Networks and Programs: develop a network of water monitoring stations at key locations to measure parameters such as contaminants, flow rates, and ecological health indicators. Engage local community members in the operation and maintenance of these monitoring stations.	
A1.5 Embrace Technology: collaborate to use tools like drones, GIS mapping, IoT (Internet of things) sensors, and data analytics to collect detailed, real-time data on water quality and flow. This information will guide restoration efforts and support community monitoring.	
A1.6 Support Existing Local Initiatives: strengthen ongoing local efforts, such as the recent "Environmental Water Protection" initiative, which focuses on certifying young First Nation individuals as professionals in water management.	

Relevant actors

First Nations, Rural Communities, Provincial Authorities, Research and Science Institutions, NGOs.

CHALLENGE A2: Maintaining potable water security in Elliot Lake

Elliot Lake is the primary source of municipal potable water for the city. Ensuring the security of this potable water reservoir is crucial, especially with anticipated population and economic growth driven by activities such as leisure, motor sports, recreation, retirement living, and environmental research. This growth is expected to increase pressure on the quality of the lake's water, heightening its vulnerability.

Causes

- **Increased Demand:** population and economic growth might put pressure on water quality.
- **Water Resource Vulnerability:** susceptibility of water resources to contamination and depletion.
- **Source Water Protection:** insufficient protection of water sources.
- **Potential Pollution:** motor sports in Elliot Lake, the city's potable water source, pose a pollution risk through chemical releases, fuel spills, and eutrophication, potentially compromising the quality of the water consumed by residents.

Collective actions	Category
A2.1 Develop Water Protection Strategy: develop a comprehensive Water Protection Strategy tailored to Elliot Lake and its watershed, identifying potential hazards and appropriate protective measures.	
A2.2 Monitor Effluent: maintain practices in effluent sampling and monitoring to mitigate risks from wastewater discharge.	
A2.3 Respond to Pollution: establish procedures for effectively responding to water pollution events in Elliot Lake due to leisure, motor sports, and recreation activities.	
A2.4 Periodically Review the Serpent River Water Monitoring Program (SRWMP): periodically assess the coverage, parameters and methods of the SRWMP currently in place, include citizen science in the monitoring, and implement a public Communications Plan for monitored data and reports.	
A2.5 Embrace Technology: collaborate to use tools like drones, GIS mapping, IoT (Internet of things) sensors, and data analytics to collect detailed, real-time data on water quality and flow. This information will guide restoration efforts and support community monitoring.	

Relevant actors

Local Authorities, First Nations, Research and Science Institutions, NGOs, Utilities.

CHALLENGE A3: Ensuring TMAs maintain their performance

Decommissioned mining operations in the Elliot Lake area are equipped with monitoring systems that oversee effluent treatment, source areas, and downstream watersheds. The data indicates that Tailings Management Areas (TMAs) have generally performed well, maintaining surface water quality within expected standards, with some exceptions. While sediment quality and benthic invertebrates are also improving, these metrics seem to lag behind surface water quality. Projected radiation exposure for the public in the Serpent River Watershed remains significantly below established public dose limits. Hence, it is crucial to ensure that the performance of TMAs does not decline over time. While operators of TMAs will continue monitoring and complying with regulatory standards, there is also room for collective action opportunities.

Causes

- **Regulatory Changes:** potential changes in environmental, safety and water quality standards.
- **Environmental Changes and Extreme Climate:** potentially affecting the structure and operation of containment and cover systems of TMAs.
- **Emerging Pollutants:** chemicals and compounds that have not yet been identified as dangerous to the environment or human health but might be considered as such in the future.

Collective actions	Category
A3.1 Practice Environmental Stewardship: implement environmental stewardship practices to minimize the ecological footprint of TMAs, encouraging the participation of local actors in their co-design and co-implementation to ensure inclusivity and shared responsibility.	
A3.2 Foster Trust: involve all relevant actors that affect the watershed in the decision-making process to foster trust. This includes First Nations, local governments, communities, and environmental groups.	
A3.3 Embrace Technology: collaborate to use tools like drones, GIS mapping, IoT (Internet of things) sensors, and data analytics to collect detailed, real-time data on water quality and flow. This information will guide restoration efforts and support community monitoring.	
A3.4 Plan for Climate Change: ensure that TMAs have a plan to address management risks from climate change such as extreme weather events, changes in precipitation patterns, and others, addressing risks such as extreme weather events and changing precipitation patterns through workshops and consultations to ensure local knowledge is incorporated.	
A3.5 Support Existing Local Initiatives: strengthen ongoing local efforts, such as the recent "Environmental Water Protection" initiative, which focuses on certifying young First Nation individuals as professionals in water management.	

Relevant actors

Local Authorities, Provincial Authorities, First Nations, Research and Science Institutions, NGOs, Mining Companies.

B. Protecting water ecosystems

CHALLENGE B1: Restoring aquatic ecosystems in the Serpent River Watershed

The Elliot Lake mining area is situated within the Serpent River Watershed. While most receiving lakes and watercourses have shown significant recovery since decommissioning began, studies have identified minor environmental concerns in certain locations. Additionally, potential impacts of forestry activities on the watershed's aquatic ecosystems and riparian areas remain a concern. These issues underscore the importance of continued efforts to protect and support the recovery of ecosystems within the watershed.

Causes

- **Persistence of Contaminants:** some TMAs could be slowly releasing contaminants over decades, potentially leading to a gradual recovery of affected ecosystems.
- **Changing Environmental Conditions:** some ecological parameters might be being altered by evolving environmental conditions.
- **Emerging Contaminants:** chemicals and compounds that have not yet been identified as dangerous to the environment or human health might be considered as such in the future.
- **Forestry Practices:** Clearcut logging and other forestry activities might disturb soil, increase erosion, and release contaminants, sediments or nutrients into nearby water bodies, and riparian areas. Degradation of these riparian zones can further compromise water quality and aquatic ecosystem health.

Collective actions	Category
B1.1 Join the Great Lakes Water Quality Agreement: integrate the Serpent River Watershed into the 1972 agreement between Canada and the United States to: • address ecological degradation from contaminants, invasive species, and habitat destruction. • invest in the cleanup of areas of concern, emphasizing the ecological and economic significance of the lakes.	
B1.2 Modernize Lake Monitoring: use satellite imagery and direct environmental sampling to continuously monitor lake water quality.	
B1.3 Embrace Technology: collaborate to use tools like drones, GIS mapping, IoT (Internet of things) sensors, and data analytics to collect detailed, real-time data on water quality and flow. This information will guide restoration efforts and support community monitoring.	
B1.4 Establish Monitoring Networks and Programs: develop a network of water monitoring stations at key locations to measure parameters such as contaminants, flow rates, and ecological health indicators. Engage local community members in the operation and maintenance of these monitoring stations.	
B1.5 Establish an initiative for sustainable forestry: involve forestry companies, local communities, First Nations, environmental organizations, and government agencies to promote sustainable forestry practices.	

Relevant actors

First Nations, Local Authorities, Provincial Authorities, Research and Science Institutions, NGOs, Mining Companies, Forestry Companies.

CHALLENGE B2: Repurposing of mining and tailings areas

Repurposing mines and tailings areas for recreation and nature-based activities offers a sustainable solution to the environmental and economic challenges posed by the mining industry worldwide. A notable example is the Milliken Mine Tailings Management Area in the Elliot Lake region, which has been successfully transformed into the Sherriff Creek Wildlife Sanctuary, a thriving bird habitat. With twelve decommissioned mining operations in the area, this case highlights the potential for collaboration between mining companies and local communities to drive innovative environmental reuse of former mine sites.

Causes

- **Environmental Remediation Needs:** old industrial areas that are no longer in use often require transformation into reclaimed, post-industrial sites to restore ecological function and create new community amenities.
- **Recreational Demand:** local communities and tourists require safe, accessible spaces for outdoor activities such as fishing, hiking, and birdwatching, driving the repurposing of these areas.
- **Economic Transition Requirements:** the decline of former mining activities drives the need for the innovative reuse of former industrial sites.

Collective actions	Category
B2.1 Support Local Initiatives: enhance and support current local projects involving First Nations in the stewardship of the Serpent River Watershed and the restoration of TMAs.	
B2.2 Follow successful examples: follow the example of converting the Milliken Mine Tailings Management Area into the Sheriff Creek Wildlife Sanctuary by looking for opportunities on transforming mining and/or tailings areas into recreational fields, wetlands, and wildlife sanctuaries.	
B2.3 Embrace Technology: collaborate to use tools like drones, GIS mapping, IoT (Internet of things) sensors, and data analytics to collect detailed, real-time data on water quality and flow. This information will guide restoration efforts and support community monitoring.	
B2.4 Foster Trust: involve all relevant actors that affect the watershed in the decision-making process to foster trust. This includes First Nations, local governments, communities, and environmental groups.	

Relevant actors

Local Authorities, First Nations, Local Communities, Research and Science Institutions, NGOs, Mining Companies.

CHALLENGE B3: Ensuring future growth is environmentally sustainable

The area is renowned for its rich Indigenous and natural heritage, with a history that includes forestry, mining, and the long-standing stewardship of the land by First Nations. Residents are deeply committed to safeguarding their environment, striving to preserve and enhance the natural beauty of their surroundings. The City of Elliot Lake aims to balance development and conservation, ensuring the city's viability while maintaining its natural charm. Given the local economy's reliance on wilderness recreation and tourism, the health of forests and watersheds is paramount. As the area prepares for future economic and demographic growth, it is crucial to ensure that this does not negatively impact wildlife, fish habitats, and significant wetlands.

Causes

- **Urban Expansion:** future commercial, industrial, and residential development.
- **Economic Initiatives:** attracting investment, fostering business growth, revitalizing industrial and commercial areas, promoting year-round tourism, and sustaining existing businesses and institutions.
- **Land Use:** provision of land for various uses including mineral resource development, mineral aggregate resource extraction, forestry, agriculture, recreational facilities (e.g., golf courses, tourist lodges), and public service infrastructure such as airports and energy facilities.

Collective actions	Category
B3.1 Engage and Educate Community: promote awareness and understanding among residents and relevant actors about the value of natural assets and the importance of environmental conservation.	
B3.2 Enforce Environmental Regulations: implement and enforce regulations and zoning ordinances to manage land use, prevent pollution, and preserve critical habitats.	
B3.3 Integrate Sustainable Land-Use Planning: integrate sustainable management considerations into planning and development decisions to ensure that growth respects ecological limits.	
B3.4 Establish Monitoring Programs: track environmental indicators, evaluate the effectiveness of conservation efforts, and adapt strategies to achieve long-term ecological goals.	
B3.5 Protect Fishing: ensure good water quality in the Elliot Lake area so that it remains a key site for recreational fishing activities.	

Relevant actors

Local Authorities, Provincial Authorities, Research and Science Institutions, NGOs, Local Communities, Business, Utilities.

C. Making sound water-related decisions

CHALLENGE C1: Adapting to climate change

Climate change poses a significant threat to water systems, altering temperatures, quality, and hydrological cycles, as well as impacting the community's ecological knowledge. Climate projections indicate significant warming in the region, with more extreme hot days, fewer cold days, increased annual precipitation, and heavier rainfall events. Winters are expected to see more rain and less snow. Increasing water temperatures can disrupt aquatic ecosystems, affecting fish distribution, spawning patterns, behaviour, and overall ecosystem health. Changes in water quality can lead to acidification and a potential rise in waterborne diseases. Alterations in water cycles can affect water levels in creeks, rivers, and lakes, disrupting traditional fishing habitats. These environmental changes can erode community ecological knowledge systems, making it difficult for First Nations to adapt to new dynamics. Addressing this comprehensive challenge requires focused research, adaptive management strategies, and the integration of traditional and scientific knowledge to protect and sustain water resources.

Causes

- **Climate Variables:** rising temperatures, changing precipitation patterns, and an evolving environment.
- **Knowledge Gaps:** insufficient understanding of how climate change impacts water systems.
- **Adaptation Research:** limited research on effective adaptation strategies.
- **Integration of Knowledge:** traditional Indigenous knowledge is often not adequately integrated into environmental research, management, and decision-making processes.

Collective actions	Category
C1.1 Integrate Knowledge Systems: develop research and policies that incorporate both Indigenous and Western knowledge.	
C1.2 Enhance Monitoring Networks and Programs: develop a network of water monitoring stations at key locations to measure parameters such as water quality, flow rates, and ecological health indicators. Engage local community members in the operation and maintenance of these monitoring stations.	
C1.3 Integrate Adaptive Management: employ adaptive management strategies that can be adjusted based on ongoing monitoring and changing climate conditions.	
C1.4 5 Develop Educational Campaigns: launch initiatives to raise awareness about the impacts of climate change on water resources.	

Relevant actors

Research and Science Institutions, First Nations, NGOs, Federal Agencies, Provincial Authorities, Local Authorities, Local Communities.

CHALLENGE C2: Forecasting the effects of climate change on groundwater

Climate change is likely to alter the characteristics of water in the Great Lakes Basin, leading to significant ecological shifts that impact both the volume and quality of groundwater. These changes might include variations in groundwater recharge, storage, and discharge, as well as interactions between groundwater and surface water. The potential exacerbation of urban development impacts, alterations in groundwater quality, and shifts in ecohydrology are also anticipated. Understanding the effects of climate change on groundwater is essential for developing adaptive management strategies, enhancing water security, protecting public health and the environment, and promoting sustainable water use amidst evolving environmental conditions. However, forecasting these effects is complicated by various uncertainties in model simulations.

Causes

- **Climate Models:** current climate models used to inform hydrological simulations often lack comprehensive representation of the Great Lakes' influence on regional climate.
- **Data Gaps:** insufficient data availability hinders accurate climate modelling.
- **Hydrological Model Complexity:** difficulty in representing the heterogeneity of hydrological systems.
- **Seasonal Processes:** inadequate representation of soil freezing and thawing processes in existing models.

Collective actions	Category
C2.1 Enhance Monitoring: increase data collection to comprehensively characterize all climate and hydrological components, including soil temperature profiles.	
C2.2 Target Research: implement research and technology initiatives aimed at filling knowledge gaps related to how climate change could alter groundwater quality and ecohydrology.	
C2.3 Improve Modelling: enhance modelling techniques to improve the predictability of climate change effects on groundwater systems.	

Relevant actors

Research and Science Institutions, First Nations, NGOs, Federal Agencies, Provincial Authorities.

CHALLENGE C3: Preparing for natural disasters

The risk of natural disasters in the Serpent River Watershed, including floods and wildfires, is a significant concern for the community and First Nations. There are concerns that natural events could impact TMAs, potentially resulting in water pollution. Moreover, the area encompasses areas susceptible to inherent natural hazards, particularly flooding. Based on community feedback, there is a perception that there is a lack of awareness of the real risk these hazards pose, which could limit the community's ability to effectively prepare for and respond to such events. his potential lack of awareness can lead to insufficient planning, inadequate community infrastructure and delayed emergency responses during disasters. Comprehensive knowledge is essential for assessing risks, implementing appropriate mitigation measures, and safeguarding community well-being.

Causes

- **Resource Constraints:** insufficient resources and research dedicated to identifying, defining, and mapping natural hazards.
- **Data Gaps:** limited availability of relevant data.
- **Lack of Preparedness:** although the risks posed by natural hazards such as wildfires and floods are generally understood, many community members lack clear guidance on how to respond effectively when these events occur.

Collective actions	Category
C3.1 Raise Awareness: increase community awareness about the importance of hazard mapping for resilience and safety.	
C3.2 Develop Communication Plan: design and implement a plan to communicate the actual risks of natural hazards in the area.	
C3.3 Embrace Technology: collaborate to use tools like drones, GIS mapping, IoT (Internet of things) (Internet of things) sensors, and data analytics to collect detailed, real-time data on water quality and flow. This information will guide restoration efforts and support community monitoring.	
C3.4 Develop Disaster Reduction Plan: develop a comprehensive Disaster Reduction Plan that covers hazard mitigation, emergency response, recovery, and long-term resilience-building, with endorsement from all societal sectors to ensure inclusivity and ownership.	

Relevant actors

Local Authorities, First Nations, Research and Science Institutions, NGOs, Utilities, Business, Local Communities, Mining Companies.

Summary of collective action opportunities

	Collaboration and Engagement	Monitoring, Science and Technology	Environmental Protection and Stewardship	Regulatory Compliance and Planning	Education and Awareness
A. Securing clean water					
CHALLENGE A1: Securing safe drinking water conditions and sanitation for First Nations and Rural Communities					
CHALLENGE A2: Maintaining drinking water security in Elliot Lake					
CHALLENGE A3: Ensuring TMAs maintain their performance					
B. Protecting water ecosystems					
CHALLENGE B1: Restoring aquatic ecosystems in the Serpent River Watershed					
CHALLENGE B2: Repurposing of mining and tailings areas					
CHALLENGE B3: Ensuring future growth is environmentally sustainable					
C. Making good water decisions					
CHALLENGE C1: Adapting to climate change					
CHALLENGE C2: Forecasting the effects of climate change on groundwater					
CHALLENGE C3: Preparing for natural hazard disasters					

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