

Four Mile Lake Management Plan

2017



**KAWARTHA
CONSERVATION**

Discover • Protect • Restore

About Kawartha Conservation

A plentiful supply of clean water is a key component of our natural infrastructure. Our surface and groundwater resources supply our drinking water, maintain property values, sustain an agricultural industry, and support tourism.

Kawartha Conservation is the local environmental agency that helps protect our water and other natural resources. Our mandate is to ensure the conservation, restoration, and responsible management of water, land, and natural habitats through programs and services that balance human, environmental, and economic needs.

We are a non-profit environmental organization, established in 1979 under the Ontario *Conservation Authorities Act* (1946). We are governed by the six municipalities that overlap the natural boundaries of our watershed and who voted to form the Kawartha Region Conservation Authority. These municipalities include the City of Kawartha Lakes, Township of Scugog (Region of Durham), Township of Brock (Region of Durham), Municipality of Clarington (Region of Durham), Township of Cavan Monaghan, and Municipality of Trent Lakes.

Cover photo: eastern shore, Four Mile Lake.

Acknowledgements

This plan was facilitated by Kawartha Conservation and developed with significant input from local communities, stakeholders, and agencies, including: local shoreline and watershed residents, members of the Four Mile Lake Association, members of the Community Advisory Panel, and members of the Science and Technical Committee

Funding for this project was provided by the municipality of the City of Kawartha Lakes



Four Mile Lake Management Plan

Executive Summary

Four Mile Lake is a peaceful lake within the municipality of City of Kawartha Lakes that is highly valued by local residents and other users for its excellent water quality and natural scenery. The *Four Mile Lake Management Plan* was developed by Kawartha Conservation, under contract from City of Kawartha Lakes, to provide several suggested actions for local individuals and groups to undertake to maintain, and wherever possible enhance, lake health.

What constitutes a healthy lake? How do we know we are sustaining lake resources? To help steer us, a vision statement has been developed as the guiding principle for the plan:

“Ensure the long-term sustainability of Four Mile Lake to maintain a peaceful and natural setting for living, boating, swimming, fishing, and access to water for household uses.”

Lake ecosystems are complex, with many interrelated components. They also change through time, mirroring changes in land use practices and naturally occurring processes in its drainage basin. Four Mile Lake is considered to be in a relatively healthy state, but there remain several challenges facing the lake. Intense shoreline development, invasive species, and other stressors if not responsibly managed do pose a legitimate threat to the future state of the lake.

The content of the *Four Mile Lake Management Plan* includes a summary of science-based information relevant to the lake health (Chapter 1), key management objectives and issues related to maintaining a healthy lake (Chapter 2), and several management recommendations to maintain or enhance lake health that can be undertaken by the various parties that are active on the lake (Chapter 3). The Plan is the culmination of a four-year planning project, initiated in 2013, whereby the City of Kawartha Lakes provided funding to Kawartha Conservation to lead its development. This included studying various components of the lake, for example water quality, water quantity, land use, aquatic and terrestrial resources, and consulting with community members, organizations, and other stakeholders to document and address their values and concerns with respect to lake health. Members of the Community Advisory Panel, the Science and Technical Committee, and local stakeholders, agencies, and organizations have been instrumental in providing guidance and review of the *Four Mile Lake Management Plan* and associated materials.

Goals:

To ensure the *Four Mile Lake Management Plan* addresses land use pressures and other community-based concerns, the following strategic goals were developed at the project onset:

- **Maintain excellent water quality in the lake and its tributaries for human use and ecological needs.**
- **Promote sustainable human and natural resources management activities that protect and enhance overall watershed and lake health.**
- **Use science-based findings to guide *Official Plan* policies, by-laws, and other strategic planning documents to ensure a supportive planning policy framework with a primary goal of protecting the lake and its watershed.**

Plan Ownership

The Plan was authored by Kawartha Conservation and submitted to City of Kawartha Lakes as fulfillment of a key funding deliverable: to develop individual Lake Management Plans for all major lakes (Four Mile Lake included) within the City of Kawartha Lakes. Ownership of the Plan therefore lies with the City of Kawartha Lakes, however, responsibility for undertaking the various management recommendations is presented in the Plan as shared amongst all major parties active in and around Four Mile Lake.

State of the Lake

Water quality within Four Mile Lake and connecting watercourses is considered to be in a good state. Important water quality parameters such as nutrient concentrations and clarity indicate no significant water quality deterioration of the lake from human use, even though the majority of the shoreline is occupied by residential development. Exceptional amounts of natural vegetative cover remain on lands and along watercourses draining into Four Mile Lake, which helps to prevent water quality impacts from the minimal residential, business, and agricultural activities that do exist within the watershed. There are local areas of water quality deterioration however, including occasional high bacterial levels at the public swimming area.

The aquatic ecology within the lake and its connecting watercourses is considered to be in a fair state. Resident fish communities are dominated by native species which include several top native predators that contribute to a recreational fishery. There has been no significant deterioration of aquatic habitats within the lake. Suboptimal dissolved oxygen levels in the deep southern basin have been documented, and could be limiting the more sensitive, coldwater fish populations. The biodiversity of the lake is under threat from invasive species, as several non-native plant and invertebrates have proliferated throughout the lake.

The water and natural resources of Four Mile Lake are influenced by various stressors that are expected to remain ongoing and perhaps even intensify into the future, including: the intensification of existing shoreline development, climate change, the threat of additional non-native aquatic and terrestrial organisms, among others. The cumulative impacts of these stressors could deteriorate water quality and aquatic ecology within the lake if responsible management is not undertaken in a collaborative manner.

Objectives:

The project management team further defined our management vision and approach through five objectives. These were formed by considering all of the science-based and agency, community, and lake stakeholder-based issues facing the lake and reorganizing them in a positive form to assist with framing management actions.

Objectives	Issues Addressed
1. Maintain excellent water quality conditions	<ul style="list-style-type: none">• Pollutants from shoreline development and activities• Occasional posting of public beach as unsafe from <i>E.coli</i>• Potential contamination from other sources
2. Maintain the biodiversity of the lake ecosystem	<ul style="list-style-type: none">• Proliferation of non-native invasive species• Wildlife species at risk
3. Enhance the natural integrity of the shoreline	<ul style="list-style-type: none">• Significant residential development along the lake shoreline• Loss and fragmentation of aquatic habitat along the shoreline

4. Improve our understanding of how the lake will respond to emerging pressures	<ul style="list-style-type: none"> Lack of coordination of research and monitoring initiatives, and information management
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Management Actions:

Upon synthesizing and analysing all available science-based information, as well as through extensive stakeholder consultations, 23 "best bet" management actions were identified and grouped under five strategic themes:

- Stewardship,
- Strategic Planning,
- Urban and Rural Infrastructure,
- Research and Monitoring, and
- Communications and Outreach.

We have tried to develop actions as specific to Four Mile Lake as possible by identifying priority areas for our management actions. Given the similar management pressures on lakes in south-central Ontario (e.g., intense shoreline development, invasive species, climate change, etc.), many of these management actions are transferable to other lakes in the region as well.

For each recommended action, these details are provided: level of priority, rationale, priority areas, agent responsible for implementation, and initiatives. The following provides a summary of key actions contained in the plan.

Stewardship Strategy:

Actions tailored to shoreline landowners and lake users for voluntarily implementing best management practices on their properties for the benefit of all and the future health of the lake.

Actions	Priority
A1: Undertake responsible management of septic systems, including routine inspections, along shoreline properties.	High
A2: Undertake measures to reduce the risk of transferring aquatic and terrestrial invasive species into the lake and its watershed.	High
A3: Manage stormwater runoff by increasing the filtering and absorbing capacity of shoreline properties.	Medium
A4: Maintain the natural features along the shoreline.	Medium
A5: Undertake responsible recreational boating within the lake, including routine equipment inspection and minimizing disturbance to sensitive habitats.	Medium

Strategic Planning Strategy:

Actions that give profile to pro-active land use policy and natural resource planning initiatives.

Actions	Priority
B1: Maintain Four Mile Lake as a Special Policy Area within the municipal Official Plan, and keep the	High

existing applicable policies intact.	
B2: Consider various regulatory options for preventing the clear-cutting of large forested areas along the shoreline.	Medium
B3: Undertake actions within the <i>Fisheries Management Plan for Fisheries Management Zone 17</i> on Four Mile Lake.	Medium
B4: Protect large tracts of land that are ecologically and/or culturally significant.	Medium

Urban and Rural Infrastructure Strategy:

Actions that focus on voluntarily maintaining sustainable public areas and construction works including lake-access areas, roads, and all construction sites.

Actions	Priority
C1: Maintain a safe and accessible public lake-access location through managing access to the boat launch and improving water quality at the beach.	Medium
C2: Ensure that construction projects, particularly road maintenance works, are conducted in a manner that does not degrade water quality or sensitive habitats.	High

Research and Monitoring Strategy:

Actions focused on addressing, through collaboration, science-based information gaps to better understand the response of the lake to emerging pressures, and tracking environmental health and plan effectiveness through time.

Actions	Priority
D1: Implement a coordinated lake monitoring program that regularly tracks key indicators of lake watershed health including nutrients, aquatic plants, forest cover, fish communities, and oxygen levels.	Medium
D2: Conduct research on aquatic plant distribution, composition, and their ecological and cultural significance to better inform lake management approaches.	Medium
D3: Conduct research to more accurately identify shoreline sources of nutrients, such as septic systems, and potential impacts to nearshore areas of the lake.	Medium
D4: Conduct research to identify how the lake ecosystem responds to stressors such as cumulative development, climate change, and invasive species.	Medium

Communications and Outreach Strategy:

Actions that encourage dialogue and information sharing among all communities, agencies, and stakeholders and promote sustainable practices to maintain a healthy lake environment

Actions	Priority
E1: Make available to shoreline residents information that clarifies options for aquatic plant control.	High

E2: Work collaboratively with people and projects that contribute to the objectives of the lake Plan.	High
E3: Communicate the science, solutions, and outcomes of plan implementation.	High
E4: Maintain the Community Advisory Panel to ensure effective communication, agency support, and collaboration among lake stakeholders during Plan implementation.	Medium
E5: Maintain the Science and Technical Committee to ensure effective communication, support, and collaboration among monitoring and research-based organizations.	Medium
E6: Create opportunities for stakeholder input through plan implementation, and regularly assess stakeholder needs, concerns, barriers, and knowledge gaps regularly.	Medium
E7: Profile the natural heritage features, social values, and economic values of Four Mile Lake, including a long-term vision for the lake and a shared sense of responsibility to protect them.	Medium
E8: Undertake Community Outreach to motivate shoreline residents to implement lake and watershed friendly lifestyles, and to make connections in the community.	Medium

Effective Implementation

Even though Kawartha Conservation is responsible for leading the development of this Plan, the undertaking of the recommended action items is a shared responsibility among all Four Mile Lake stakeholders. Watershed residents, shoreline residents, local businesses, agencies, and organizations have a role to play, and as such have been identified wherever possible within the *Four Mile Lake Management Plan* as most appropriate to lead, or partner, on one or more of the recommended actions. All of the actions recommended in the Plan are not legally-binding, that is they are voluntary and not mandated to be undertaken by watershed stakeholders. A healthy Four Mile Lake will likely only be realized if reasonable efforts are made among all watershed stakeholders towards successful collaboration, communication, and accountability.

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Acronyms and Unit Conversions

ug/L: Micrograms per litre

m: Metres (1 m = approx. 3.3 feet)

km: Kilometres (1 km = approx. 0.6 miles)

km²: Square kilometres (1 km² = approx. 0.386 miles² = 100 hectares = approx. 250 acres)

ha: Hectares (1 ha = 0.01 km² = approx. 2.47 acres)

kg: Kilograms (1 kg = approx. 2.2 pounds)

m³: Cubic metres (1 m³ = approx. 35 cubic feet)

1.0 Setting the Context



Rock outcroppings, a common sight along the north shore of Four Mile Lake
(August 2016)

1.1 Introduction

The *Four Mile Lake Management Plan* is the culmination of a four-year study coordinated by Kawartha Conservation and funded by the municipality of the City of Kawartha Lakes. The Plan is a community-driven endeavour, providing a framework for the voluntary implementation of collaborative strategies for maintaining the health of Four Mile Lake and its watershed for all uses. Kawartha Conservation's role in the development of the Four Mile Lake Management Plan is one of a facilitator and lead author. The focus is to build consensus among a broad spectrum of watershed partners, organizations, and residents whom will ultimately share responsibility (on a voluntary basis), for undertaking the recommended management actions.

Four Mile Lake is situated within the municipality of the City of Kawartha Lakes, located west of the Village of Burnt River and east of Coboconk. Waters from Four Mile Lake flow south into the east shore of Balsam Lake through Corben Creek, and eventually flow through the Kawartha Lakes and the Trent River into the Bay of Quinte and out to Lake Ontario.

The overall drainage area into Four Mile Lake, including the lake itself is approximately 50.8 square kilometres (km²). The lake can be considered a 'headwater lake', having a relatively small drainage area with no significant water flow through. This means that the water in the lake has a smaller flushing rate and thus its water quality is more directly influenced by its immediate surroundings (developed shoreline areas, for example) than other neighbouring lakes where water quality is more influenced by upstream influences (Shadow Lake, for example, is a flow-through lake).

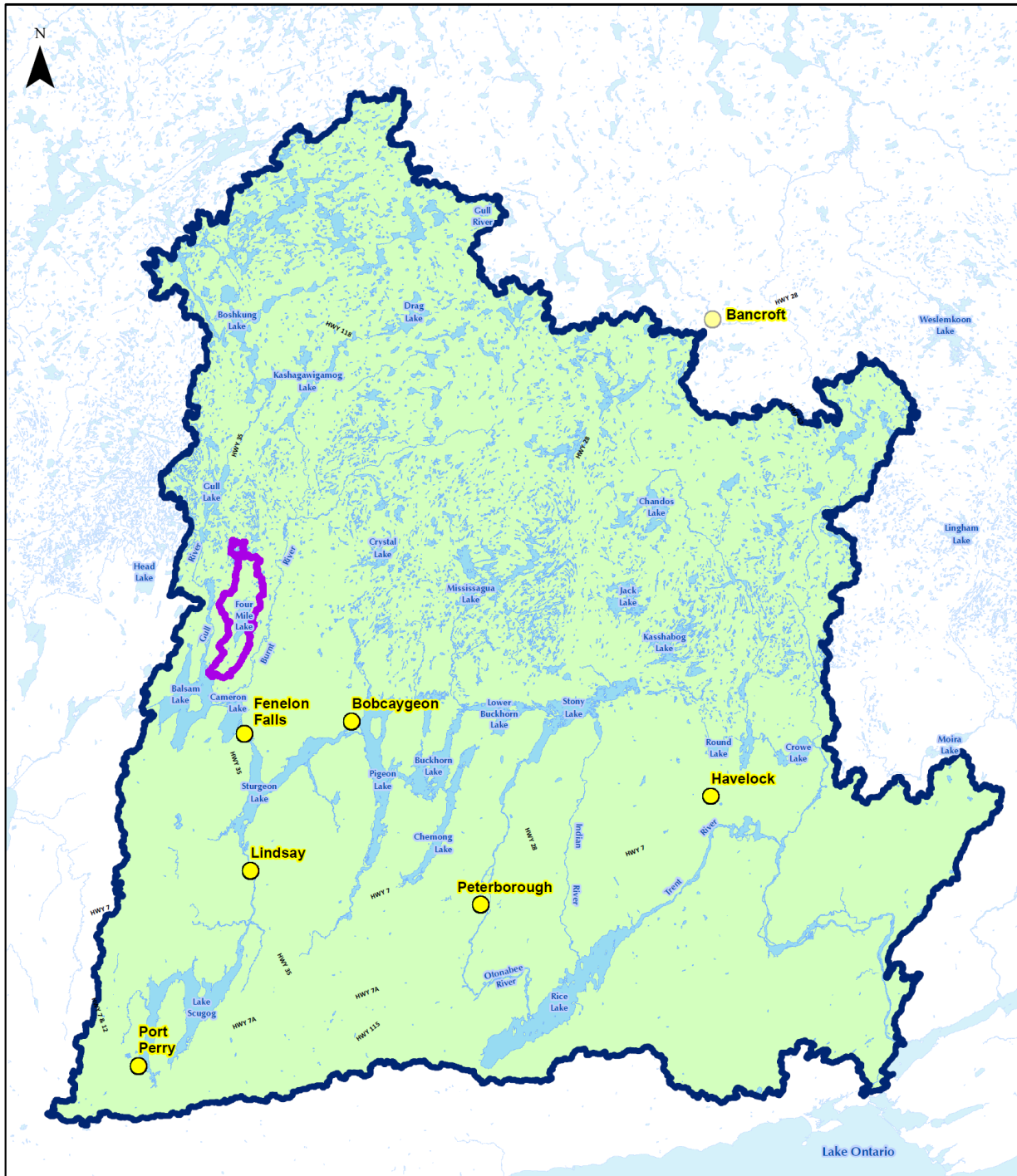
The core management planning area of the *Four Mile Lake Management Plan* is 69.1 km² (Figure 1.2). This boundary is defined as all lands and water upstream of where Corben Creek drains into Balsam Lake and includes Four Mile Lake, all areas that drain into the lake, and the drainage area of its outflow watercourse (Corben Creek). The planning area encompasses two municipalities, City of Kawartha Lakes and Township of Minden Hills.

Document Layout

Chapter 1 provides the foundation upon which the *Four Mile Lake Management Plan* is developed and includes a summary of lake management drivers, stakeholder values and concerns, management vision and goals, and background characterization.

Chapter 2 provides a summary of management objectives. These include the aspirations of lake-based stakeholders, agencies, and organizations and ultimately provide the foundation for the Implementation Strategy. Within each objective, a number of issues hindering their achievement have been presented.

Chapter 3 presents the preferred lake management actions that address the key points and issues identified in the previous chapter. These actions are categorized into five strategies focused on sector-based action items. The strategies include Stewardship, Strategic Planning, Urban and Rural Infrastructure, Research and Monitoring, and Communications and Outreach.



Trent River Watershed

- Four Mile Lake Planning Area
- Trent River Watershed

0 5 10 20 30 40 Kilometres

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 Geospatial Data Exchange.
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 Additional Data Sources

Figure 1.1: Map showing the Four Mile Lake Planning area, in relation to the entire Trent River drainage basin

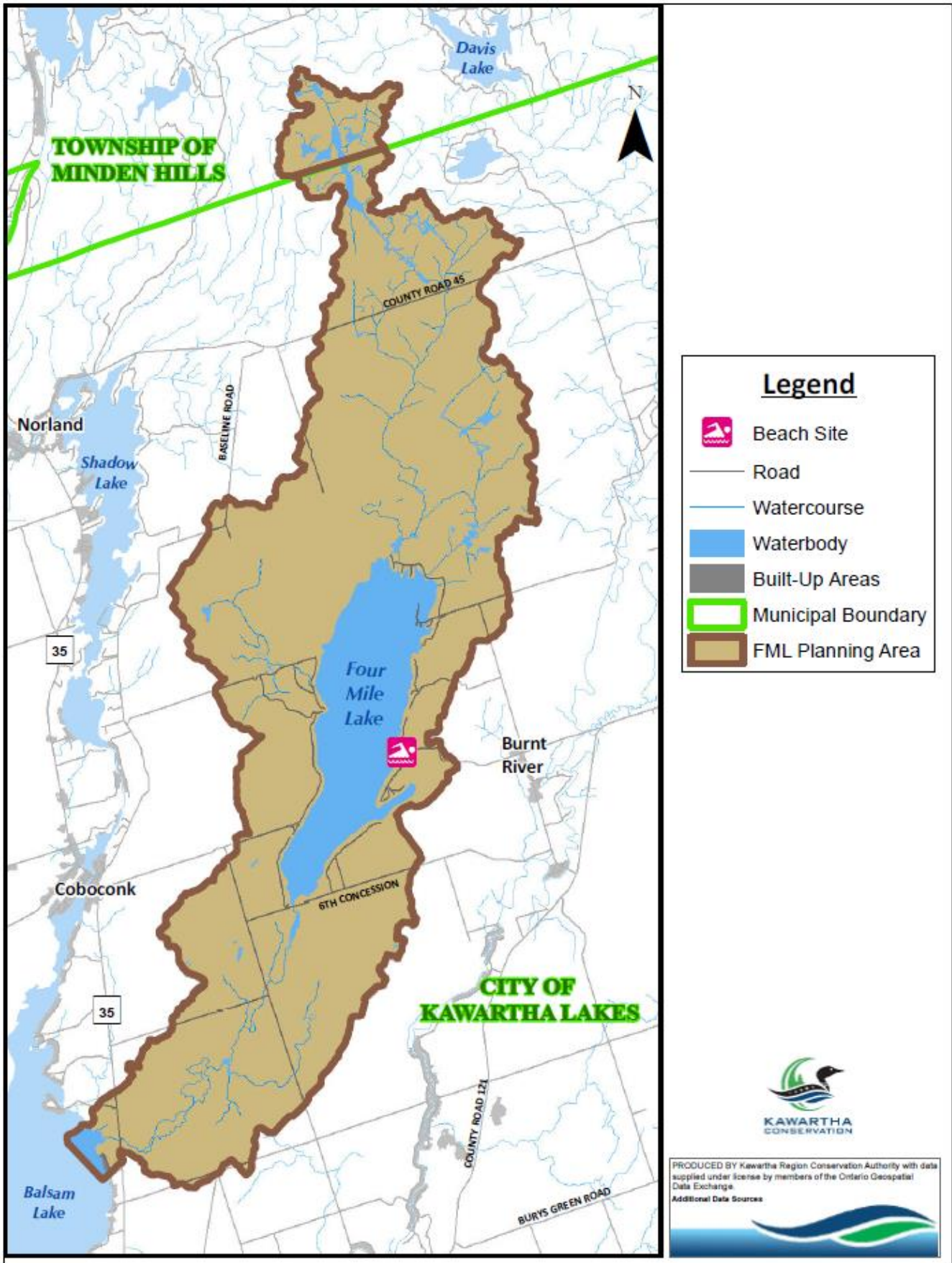


Figure 1.2: Map showing the Four Mile Lake Planning area

1.2 Lake Management Drivers, Values, and Concerns

Four Mile Lake is a water resource of the utmost value to local municipalities, First Nations, shoreline residents, seasonal visitors, and local businesses. Surrounding communities benefit from its economic, environmental, and recreational enjoyment opportunities. For many people, particularly shoreline residents, the lake is an integral part of their identity and livelihood.

The following reports, studies, and recent developments demonstrate the imperative for lake management plans for the Kawartha Lakes, including Four Mile Lake:

- In the 1970's, Four Mile Lake was studied to support the development of the Lakeshore Capacity initiative, a project led by the province of Ontario to attempt to predict water quality changes from shoreline development. At this time, attempts to locate a 'summary of findings' document have not been successful. [note we have requested the archived document from Ontario Ministry of Municipal Affairs and Housing and are awaiting response]
- In 1986, the Four Mile Lake Association commissioned a comprehensive study and report by Michalski Associates entitled: *Four Mile Lake Evaluation of Fish and Wildlife Habitat*. This report was the first comprehensive study of the lake and concluded that intense shoreline development around the lake should be better managed in order to sustain the recreational and ecological health of the lake.
- In 2001, a follow up study to the above report was conducted by Briones and Kelly entitled *Four Mile Lake Environmental Update*. This report was undertaken by local volunteers, and reached similar conclusions as the Michalski report and recommended more community-led management and monitoring of the lake.
- In 2002, a report commissioned by the City of Kawartha Lakes, titled *Shoreline Environmental Studies in Support of Official Plan Policies for the City of Kawartha Lakes* (Gartner Lee and French Planning Services, 2002), recommended that the municipality encourage the development of individual lake management plans as a cooperative process among lake residents, the municipality, businesses, and provincial and federal agencies.
- In 2008 and 2009, the City of Kawartha Lakes Environmental Advisory Committee hosted a series of Environmental Roundtables, inviting various community representatives to put forward initiatives to help realize their goals of protecting the environment. Twenty-two local associations and organizations with an interest or role in water quality participated. By a wide margin, lake management planning was selected as the number one priority.
- In 2009, a municipal staff report was presented to council, outlining support for lake management plans that aim to sustain healthy lakes. Council supported recommendations that lake management planning actions be coordinated by the local conservation authority. Following the commencement of the Sturgeon Lake Management Planning project, Kawartha Conservation entered into a four-year partnership (2013 to 2016) with the City of Kawartha Lakes to lead the development of the *Four Mile Lake Management Plan*.
- In 2012, the City of Kawartha Lakes adopted a new Official Plan; the primary goal is to enhance and protect the quality of the natural environment within the municipality, with a particular emphasis on maintaining healthy water resources. Four Mile Lake is classified as a "Special Policy Area" within the Official Plan and has a distinct set of policies intended to provide enhanced lake protection, particularly with respect to new development.
- In 2013, the Our Kawartha Lakes Integrated Community Sustainability Plan (City of Kawartha Lakes. Draft, 2013) identified numerous water sustainability goals, and the municipality now seeks to achieve many of these through a lake management planning process.

- Beginning in 2014, several lake-specific management plans have been developed by Kawartha Conservation, including *Sturgeon Lake Management Plan*, *Balsam Lake and Cameron Lake Management Plan*, and *Pigeon Lake Management Plan*. These plans helped to guide the development of the *Four Mile Lake Management Plan*.

Community-Based Values and Concerns

Throughout the development of the *Four Mile Lake Management Plan*, significant effort was placed on gathering input from local stakeholders, agencies, and organizations. Particularly, guidance was received from the Community Advisory Panel, a group of committed individuals that met on a routine basis and provided invaluable project support and insight into "what the community wants for their lake."

The following provides a list of key values (Table 1.1) and concerns (Table 1.2) identified by the lake community as priorities for lake management. These were obtained from consultations with public and lake-specific stakeholders, agencies, and organizations primarily through the Strategic Visioning process undertaken by the City of Kawartha Lakes in support of their Official Plan, as well as Kawartha Conservation Blue Canoe shoreline communication program (summers of 2013 to 2016), a series of public open houses (summer 2016), several Community Advisory Panel meetings and Science and Technical Committee meetings, and conversations at Four Mile Lake Annual General Meetings.

To ensure the lake-based values remain, and lake-based concerns are addressed, a coordinated management approach by all local stakeholders, agencies, organizations (see Appendix A) is required. Open house events provided a clear indication that the lake community is well aware of the issues and will work together with partners who provide effective leadership and a sound action plan.

Table 1.1: Lake values identified by community stakeholders

Values	Details
Excellent Water Quality	Of utmost importance for lake stakeholders is to maintain excellent water quality, particularly to support recreational use and aquatic communities within the lake. Further, there are numerous private water intakes along the shoreline that provide water for domestic purposes.
Unique Alvar Areas, Fish and Wildlife Habitat	Four Mile Lake is located in an ecologically significant area known as "The Land Between," which supports a high diversity of environmental, geologic, and cultural elements. Functioning and abundant habitat support healthy populations of fish and wildlife that provide ample viewing and fishing opportunities.
Peaceful and Quiet Ambience	Most individuals value the lake as a place of clean water, relaxation, and beautiful scenery. Four Mile Lake, due to its relatively remoteness and not being navigably-connected to the Trent-Severn Waterway provides a unique lake setting, offering natural beauty within close proximity to urban and agricultural areas.
Lack of Commercial, Industrial, and Residential Cluster and Backlot Development	Most of the development within the planning areas exists along the shoreline of Four Mile Lake in single residential lots. A protected and naturally functioning landscape is a key characteristic of the Four Mile Lake landscape and helps to maintain its unique identity.
Good Fishing and Recreational Opportunities	The lake is known for excellent boating and swimming potential. Recreational fishing is particularly popular and the lake supports several desirable sportfish such as: Smallmouth Bass, Walleye, and Muskellunge.
Safe Access to Lake	Safe access to the lake is a key priority for local residents, particularly those who utilize the public boat launch area. To maintain a safe swimming area, the Four Mile Lake Association in partnership with the City of Kawartha Lakes maintain seasonal gated access to the public facility, with hours specified for swimming and other beach activities, and hours offering access for boats.

Table 1.2: Lake concerns identified by community stakeholders

Concerns	Details
Poorly Functioning Septic Systems	Potential for faulty or inadequate septic systems/tanks from aging shoreline dwellings, resulting in high nutrient inputs and/or contamination, especially in the nearshore zone.
Shoreline Alterations	Changes to the natural features and functions of the shoreline and nearshore environments, including installing artificial structures, hardening, and manicured landscaping.
Boating Disturbance and Potential Pollution	Disturbing sensitive areas and shorelines through power-boating, potentially leading to impacts to fish and wildlife and shoreline erosion. Concerns regarding potential pollution from power-boats resulting from contaminant spills due to lack of equipment maintenance and/or unforeseeable circumstances (e.g., gas/oil leaks).
Nuisance Aquatic Plants	Personal observations among shoreline residents suggest an increase in aquatic plant abundance has occurred in recent years, leading to impairments of recreational use such as swimming and boating, particularly in shallower sections of the lake.
Public Swimming Safety	The health and safety risks associated with boat launching within the public swimming area, particularly during periods of children’s swim events/lessons.
Invasive Species	The introduction and potential proliferation of non-native species (plants, fishes, and invertebrates) that could outcompete or displace native species and impair recreational use of the lake.
New Large-scale Development	Negative impacts to water quality, natural heritage, and aesthetics associated with potential new large-scale developments such as: renewable energy projects (e.g., solar farms), estate shoreline properties, and subdivisions.

1.3 Management Vision and Goals

The *Four Mile Lake Management Plan* seeks to solidify a common respect for the lake, maintain a healthy resource for our current generation, and sustain healthy conditions for future generations. The issues facing the lake will not be addressed overnight. As such, the plan should be considered a long-term endeavour, one that will be achieved only through ongoing collaboration.

The Vision of Four Mile Lake is to

“Ensure the long-term sustainability of Four Mile Lake through ongoing stewardship to maintain a peaceful and natural setting for living, boating, swimming, fishing, and access to water for household uses.”

The Goals of the *Four Mile Lake Management Plan* are as follows:

- Maintain excellent water quality in Four Mile Lake and its tributaries for human use and ecological needs.
- Promote sustainable human and natural resources management activities that protect and enhance overall watershed and lake health.
- Use science-based findings to guide *City of Kawartha Lakes Official Plan* (and those of other local municipalities) policies, by-laws, and other strategic planning documents to ensure a supportive planning policy framework with a primary goal of protecting the lake and its subwatersheds.

Management actions are guided by the following principles:

- Promote an ecological approach to the use of land and water as a fundamental perspective to a healthy lake and as the foundation for effective land use planning within the lake’s watersheds.
- Recognize the links between human health and environmental health, while supporting a healthy economy.
- Maintain a watershed-scale perspective and consider the implications of cumulative actions on the lake basin as a whole.
- Recognize that management is a shared responsibility and requires a shared approach to coordination and implementation of actions.
- Utilize lessons learned from management planning exercises conducted on other local lakes to help better inform management recommendations.

1.4 Roles and Responsibilities

The Plan was authored by Kawartha Conservation and submitted to City of Kawartha Lakes as fulfillment of a key funding deliverable: to develop individual Lake Management Plans for all major lakes (Four Mile Lake included) within the City of Kawartha Lakes. Ownership of the Plan therefore lies with the City of Kawartha Lakes, however, responsibility for undertaking the various management recommendations is presented in the Plan as shared amongst all major parties active in and around Four Mile Lake (Table 1.3). These parties (including local residents, Kawartha Conservation, City of Kawartha Lakes, Ontario Ministry of Natural Resources and Forestry, among others), are listed for each recommendation in Chapter 3 of this Plan as being the most appropriate entity that should be responsible to lead, co-lead, or partner on implementation activities. The plan is not legally binding, therefore implementation is expected to occur on a voluntary basis as willingness, opportunity, and resources become available to the various parties.

Table 1.3: Definition of the roles of various key players in the management of Four Mile Lake.

Partner	Typical Role	Role in Plan Development	Role in Plan Implementation
Kawartha Conservation	<ul style="list-style-type: none"> Review Planning Act proposals (e.g., minor variances, severances, Plans of Subdivision, etc.) as per Service Agreement with City of Kawartha Lakes, and provide recommendations to ensure conformity with Provincial Policy Statement for Natural Hazards, Natural Heritage Features, and Water Resources. Note Kawartha Conservation does not regulate development within the Four Mile Lake Planning Area, as it is outside the Regulated Areas of any conservation authority. 	<ul style="list-style-type: none"> Hired by City of Kawartha Lakes to study the lake, meet with local stakeholders, and produce a Plan in 2017 that provides several recommendations towards maintaining a healthy lake. Undertake a multi-year (2013-2016) science-based study of water resources in lake and its watershed. Organize and facilitate public consultation and communication (e.g., local open houses, stakeholder meetings, media releases, etc.). Lead writer of Management Plan and Characterization Report. 	<ul style="list-style-type: none"> Co-lead on undertaking some recommendations within Communication and Outreach strategy. Partner on undertaking several recommendations within Stewardship, Research and Monitoring, and Communications and Outreach strategies. Implementation role after 2017 to be determined on an annual basis.
City of Kawartha Lakes	<ul style="list-style-type: none"> Administer land use policies and bylaws as per Official Plan, including those within Four Mile Lake Special Policy Area. Undertake public infrastructure works (e.g., maintenance on local and county roads and ditches, etc.). Approve septic system works as per Ontario Building Code. 	<ul style="list-style-type: none"> Hired Kawartha Conservation on a 4-year project basis to study the lake, meet with local stakeholders, and produce a Plan in 2017 that provides several recommendations towards maintaining a healthy lake. Provide input into the process and review key documents. 	<ul style="list-style-type: none"> Lead on undertaking several recommendations within Strategic Planning strategy. Co-lead on undertaking several recommendations within Communications and Outreach, Stewardship, and Urban and Rural Infrastructure strategies. Partner on undertaking several recommendations within Communications and Outreach, Stewardship, Strategic Planning, and Research and Monitoring strategies.
Residents and community members residing along shoreline and in watershed.	<ul style="list-style-type: none"> Maintain access to the public beach and boat launch (Four Mile Lake Association). Routine sampling of lake water quality as per volunteer-based Lake Partner Program. Live, work, socialize, and recreate. 	<ul style="list-style-type: none"> Provide input into the process and review key documents. Some residents participated on the Community Advisory Panel, while others provided one on one input upon request following the 2016 Open Houses 	<ul style="list-style-type: none"> Lead on undertaking several recommendations within Stewardship, and Communications and Outreach strategies. Co-lead on undertaking several recommendations within Stewardship, Urban and Rural Infrastructure, Research and Monitoring, and Communications and Outreach strategies. Partner on undertaking several recommendations within Stewardship, Strategic Planning, and Communications and Outreach strategies.
Ontario Ministry of	<ul style="list-style-type: none"> Administer land use policies as per 	<ul style="list-style-type: none"> Provide input into the process and 	<ul style="list-style-type: none"> Lead on undertaking recommendation

Partner	Typical Role	Role in Plan Development	Role in Plan Implementation
Natural Resources and Forestry	<p><i>Public Lands Act</i> and <i>Lakes and Rivers Improvement Act</i>, which includes reviewing and approving most development proposals along the shoreline and in the lake.</p> <ul style="list-style-type: none"> • Administer policies as per Endangered Species Act (e.g., ensuring species and habitats of Endangered or Threatened species are protected), and Fish and Wildlife Conservation Act (e.g., fishing and hunting regulations). • Support invasive species management, including Invading Species Awareness Program. • Monitor recreational fishery as per Broad Scale Monitoring program. 	<p>review key documents.</p> <ul style="list-style-type: none"> • Active participant on the Community Advisory Panel during lake studies and plan preparation. 	<p>within Strategic Planning strategy.</p> <ul style="list-style-type: none"> • Co-lead on undertaking some recommendations within Research and Monitoring and Communications and Outreach strategies. • Partner on undertaking several recommendations within Communications and Outreach, Stewardship, Research and Monitoring, and Strategic Planning strategies.
Haliburton Kawartha Pine Ridge District Health Unit	<ul style="list-style-type: none"> • Monitor water quality at the public beach during the swimming season for safe swimming. 	<ul style="list-style-type: none"> • Provide input into the process and review key documents. 	<ul style="list-style-type: none"> • Partner on undertaking some recommendations within Research and Monitoring and Communications and Outreach strategies.
Fisheries and Oceans Canada	<ul style="list-style-type: none"> • Administering policies as per the Fisheries Act, including reviewing and approving proposals that have potential to cause serious harm to fish habitat that supports the local fishery. 	<ul style="list-style-type: none"> • Minimal, provide input into the process and review key documents. 	<ul style="list-style-type: none"> • Partner on undertaking some recommendations within Strategic Planning strategy.

1.5 Lake Background Characterization

To provide background information on the current environmental state of Four Mile Lake and its subwatersheds, a companion report was developed alongside the *Four Mile Lake Management Plan* that characterizes current lake conditions. This report, the *Four Mile Lake Watershed Characterization Report* (Kawartha Conservation, 2016, in draft), presents current information on lake resources (such as land use trends, water quality trends, etc.) as well as their functions, linkages, key issues, and information gaps.

In characterizing Four Mile Lake, the project team has drawn upon all available data, studies, and sampling results and combined this information into a report for review and update as required. This background information, compiled primarily by specialist staff of Kawartha Conservation and vetted through science-minded peers, and other community groups helped to inform management decisions and actions developed through the planning process.

The following is a summary of the report findings, presented in five key themes: Land and Lake Use, Water Levels and Flows, Water Quality, Aquatic Ecosystems, and Terrestrial Natural Heritage.

1.5.1 Land and Lake Use

The history of human activities on the landscape around Four Mile Lake is linked to the progression of events occurring in other areas in south-central Ontario. First Nations Peoples have been documented as residing in the area in and around the Kawartha Lakes for thousands of years, owing in large part to the abundance of lakes and connecting corridors for hunting, fishing, and transportation routes.

European settlement expanded into the area in the early-to-mid 1800's, with the surveying of Somerville Township. Over the years there was a gradual but steady shift from exploiting the lake's watershed resources for commercial purposes to non-intensive agricultural use and using the lake for recreational purposes. Supported by the lumber industry thanks to the regions vast forests, and access to markets through running logs along the Trent Waterway and later the Victoria Railway, the landscape was exploited for its forests resources until the end of the century. As documented by Howe and White (1913), *"Somerville has practically no forest containing saw-logs, outside of a few swamps and farm wood-lots. Sixty-one and seven-tenths per cent of the area is occupied by the old burn type. The mixed forest comprises 5.1 per cent, the hardwoods 4.4 per cent, and the conifers 1.3 per cent of the area ; and all three of these types have been severely culled."*

In an effort to replace forests either lost through logging or wildfire, the Victoria County Forest and Somerville Tract were planted in the late 1920's in the northeast section of the Four Mile Lake watershed. Later a large section of wetlands and forests were protected and named the Altberg Wildlife Reserve.

By the mid-20th century, the landscape remained mostly natural cover interspersed with non-intensive agricultural lands and small hamlets. These natural lands are regrowth areas that were cleared for logging, succumbed to wildfires, too wet or rocky to farm productively, or abandoned as non-productive farmland. The Four Mile Lake shoreline became heavily settled with residential cottages and dwellings during and after this time period. In recent years, the shoreline has supported a more permanent population through conversions of seasonal to year-round residences, and it has steadily become more attractive as a retirement destination.

Today, the major land use types in the planning area are natural areas (77%), open water (13%), agriculture (6%), and development (4%), (Figure 1.3). The majority of the watershed is natural cover, owing in large part to large expanses of forest and wetlands, and protected areas such as Victoria County Forest, Somerville Tract, and Altberg Wildlife Reserve. Due to the relatively shallow soils, farmland occurs sparingly and is dominated by pasture lands.

Census information from 2013 (ESRI, 2016) indicates a permanent human population of 380 people within the Four Mile Lake planning area, the majority of whom reside along the Four Mile Lake shoreline. Most of the developed areas in the planning area are located as residential properties along the shoreline of Four Mile Lake, and scattered in rural residential settings. There are also a small number of active aggregate operations and a solar farm. There is a significant summer influx of seasonal residents along the shoreline due to cottage, tourism, and recreational opportunities.

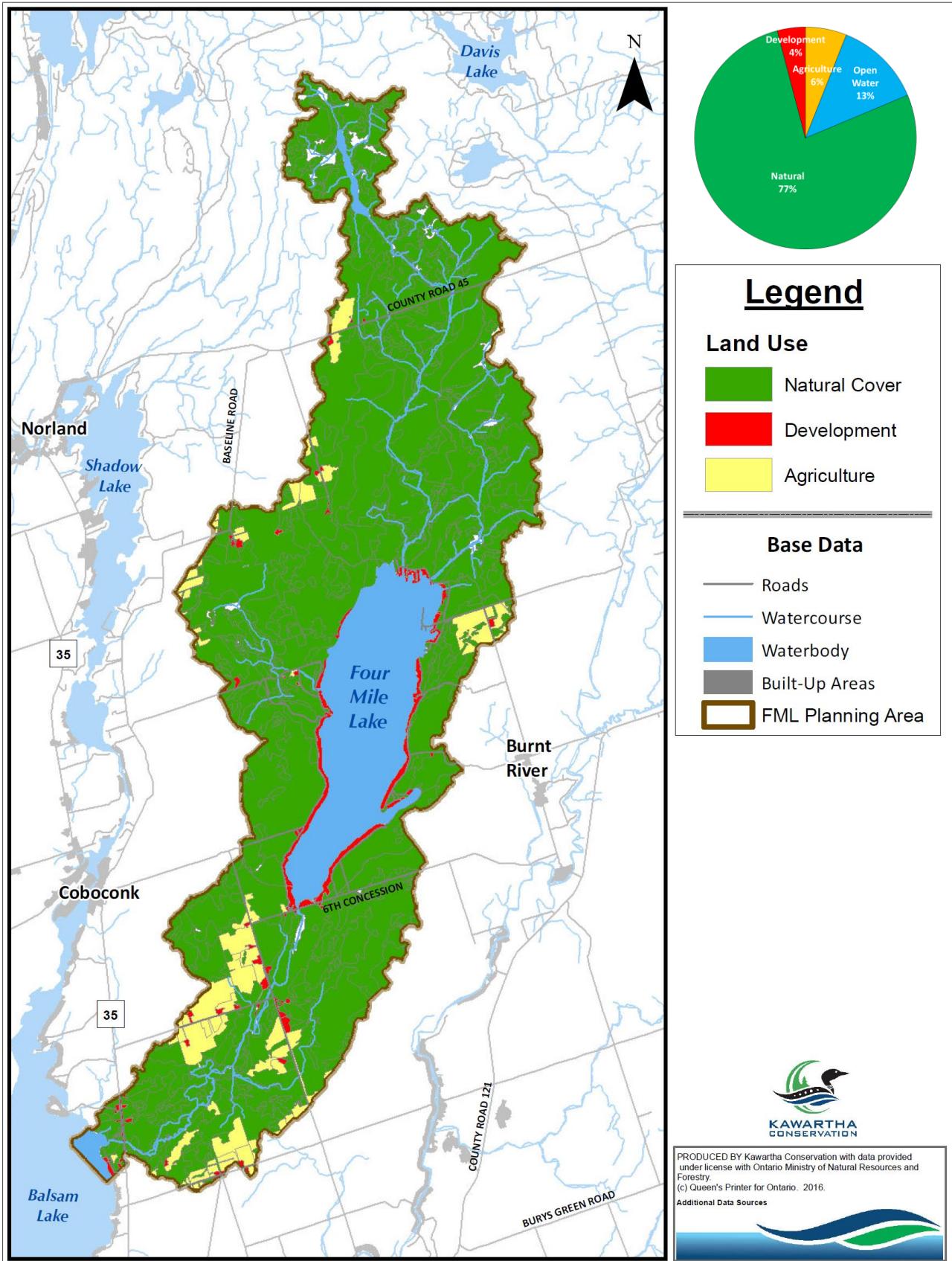


Figure 1.3: Map showing major land use types within the Four Mile Lake planning boundary

Shoreline

The shoreline of Four Mile Lake is approximately 21 km in length. As shown in Figure 1.3, and Table 1.4, development within the planning area is heavily concentrated along the shoreline of Four Mile Lake. As of 2013, approximately 73% of the shoreline on Four Mile Lake has been developed within a 30-metre distance from shore. Natural shoreline vegetation within this settled area in many cases has been altered and/or cleared to accommodate cottage or residential property development.

As of 2016 there are approximately 409 shoreline residences within 75m of the lake, of which 193 are permanent and 216 are seasonal dwellings. Generally, along the Four Mile Lake shoreline there has been a recent shift to more permanent home dwellings as seasonal dwellings are being upgraded to four-season residences.

As a consequence of increased development intensity, several sections of the shoreline have been significantly altered at the water's edge (that is, the shore/water interface). In Four Mile Lake, as of 2016, it is estimated that 8%, or 1.8 km in length of the water's edge consists of artificial land use including concrete, wood, manicured lawn, armour stone, and other materials (Figure 1.5).

Table 1.4: Table showing major land use types along the Four Mile Lake shoreline, within varying distances from shore.

Distance from Shore:	15m	30m	100m	500m
Developed (%)	73	73	58	15
Natural (%)	27	27	42	84
Agricultural (%)	0	0	0	1

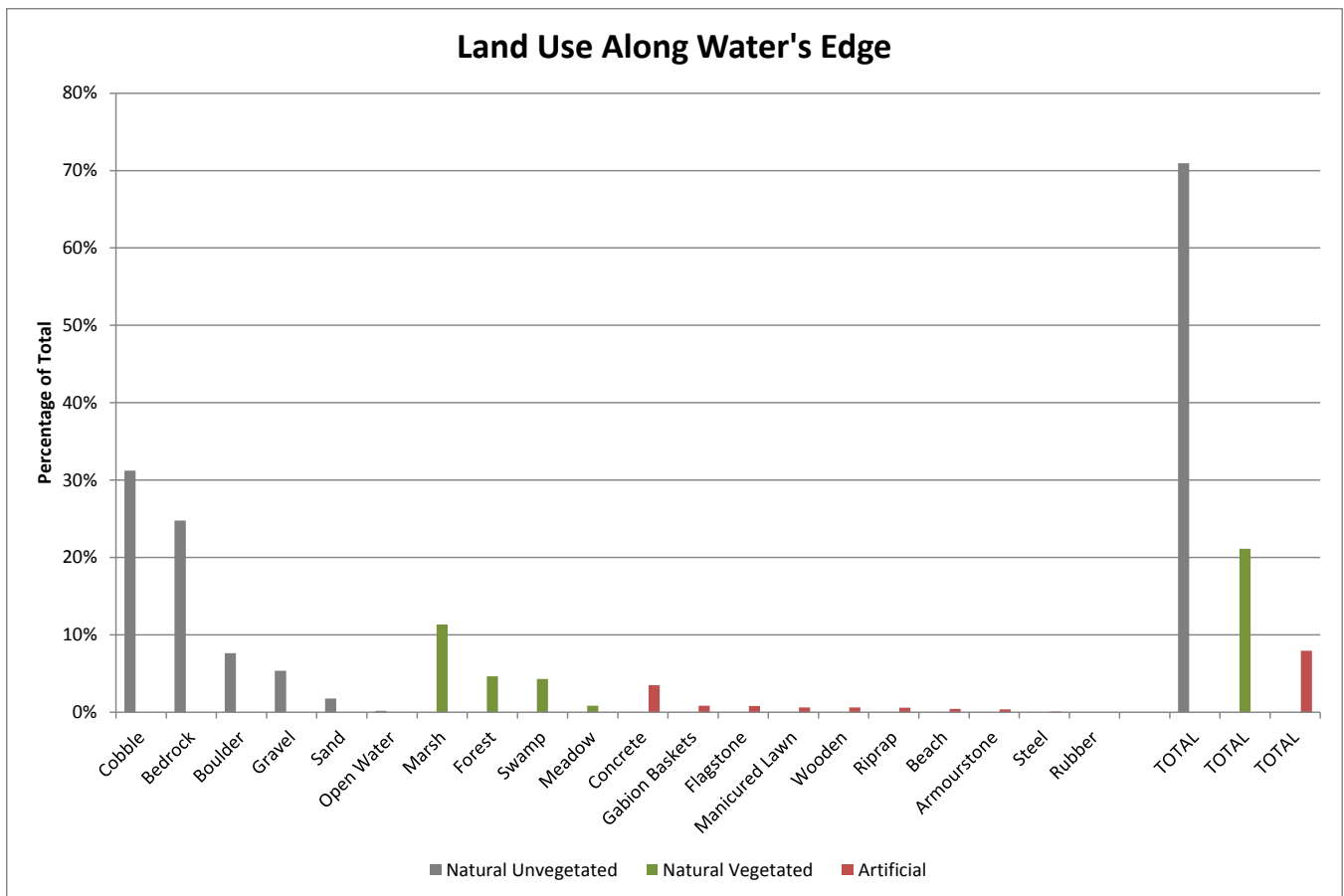


Figure 1.5: Major land use characteristics at the water's edge of the Four Mile Lake shoreline.

Tourism and Recreation

Although Four Mile Lake is hydrologically connected to the Kawartha Lakes via Corben Creek to Balsam Lake, there is no boating corridor to large neighbouring lakes. Four Mile Lake is therefore relatively isolated. The lake provides ample opportunities, particularly for local shoreline residents, for swimming, boating (power, canoe, and sailboat), and fishing, all of which are key recreational activities on the lake.

Historically, lakes within the Kawartha Lakes region have attracted significant numbers of anglers because of highly desired fish stocks (especially walleye) and high natural productivity of the lakes. Within Fisheries Management Zone 17 (i.e., the Kawartha Lakes region and coldwater streams along Lake Ontario, including Four Mile Lake), it is estimated that investment expenditures related directly or indirectly to fishing totaled approximately \$114 million in 2005 alone (Ontario Ministry of Natural Resources, 2010).

There is one active public beach on Four Mile Lake, existing at the end of Hillside Drive along the eastern shore, just west of the Village of Burnt River. Compared to many other beaches within the municipality, this beach has relatively good water quality although within the last five years it has been posted as potentially unsafe for swimming due to high *E.coli* levels in approximately 12% of times sampled, which equates to just over 1 posting a year. This area is also the only public boat launch along the lake. To facilitate access while maintaining a safe swimming environment, there is a local bylaw that restricts access to the boat launch during swimming hours through a locked gate.

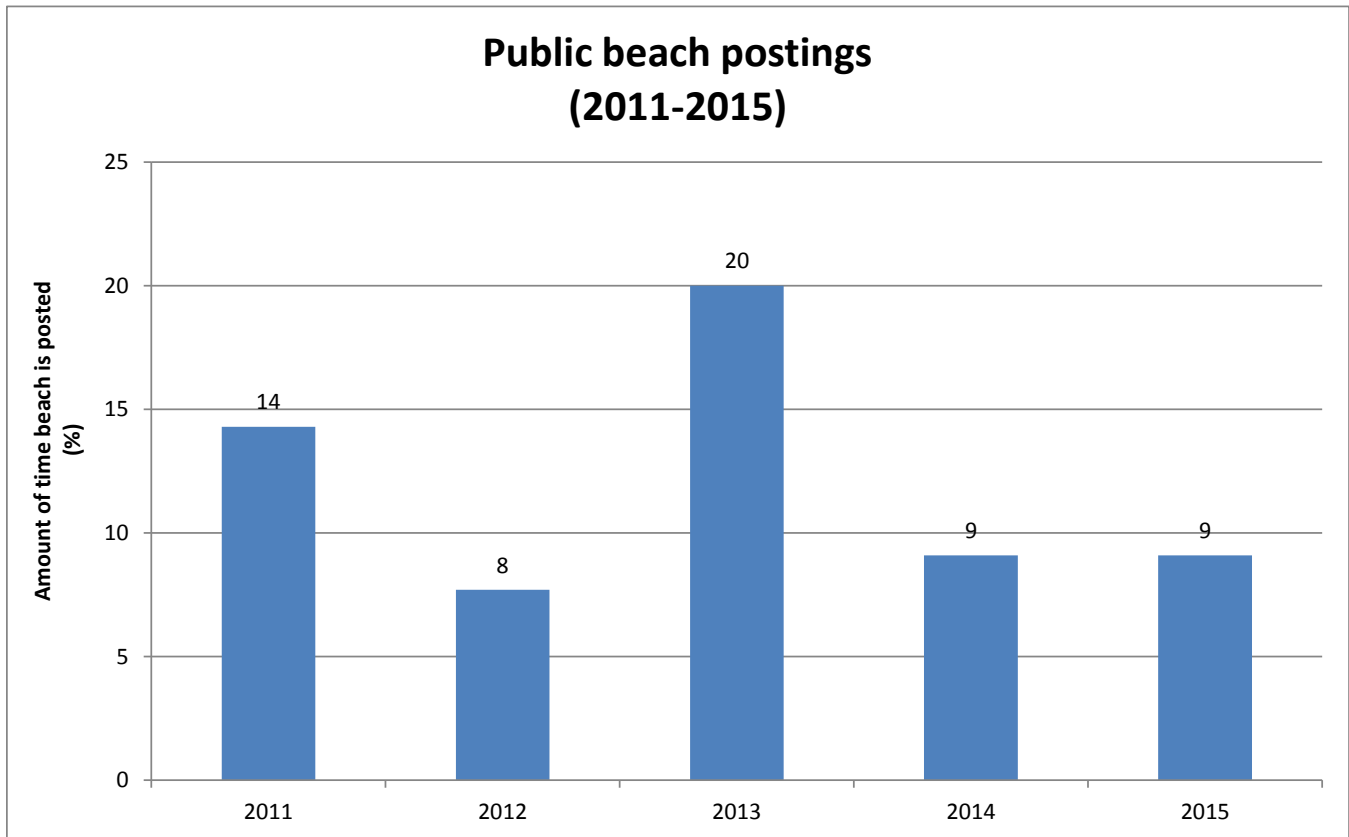


Figure 1.6: The amount of time (in percent) the public beach has been posted during the swimming season (June, July, and August), between 2011 and 2015.

The seasonal influx of vacationers into the City of Kawartha Lakes in the summer months is approximately 17,500 (which equals an increase of 25% of the population), who mostly visit cottages and lakeside communities including Four Mile Lake. The total seasonal population within the municipality is forecast to grow from 31,000 (as of 2006) to approximately 37,500 by 2031. In 2008, an estimated total of 1,263,000 personal visits were made to the City of Kawartha Lakes, 56% of which were made for pleasure, making it the seventh most visited destination in Ontario.

Drinking Water and Wastewater

There are no municipal intake systems that draw water from Four Mile Lake. Private residences along the shoreline obtain their water from groundwater wells and personal or communal surface water intakes. In terms of wastewater, all residents along Four Mile Lake are on private septic systems.

1.5.2 Water Levels and Flows

The surface area of Four Mile Lake is approximately 7.6 km², making it the one of the smaller important lakes within the City of Kawartha Lakes. The lake contains approximately 70.5 million cubic metres (m³) of water, and has an

average depth of 9.3 metres and a maximum depth of 19.1 metres. Flows into and out of Four Mile Lake are not regulated.

Four Mile Lake, on average, receives 25.6 million m³ of water flow every year. Most of this water (42%) comes from Corben Creek North subwatershed which outlets into the lake at its north end under Woodworth Dr. (Figure 1.7). The remaining water inputs include direct precipitation onto the surface area of the lake (28%), drainage from the central basin also known as Four Mile Lake Central subwatershed (16%), and Merrett Creek subwatershed (15%). Water exits the lake at its south end through Corben Creek into Balsam Lake, and eventually continues in a general southeast direction through the Kawartha Lakes, eventually draining into Lake Ontario through the Trent River and the Bay of Quinte. The locations of all defined subwatershed areas of Four Mile Lake are shown in Figure 1.8.

Lake flushing rate is an average rate at which water enters and leaves a lake relative to lake volume. It is usually expressed as time needed to replace the lake volume with inflowing water. Using inflow volumes, calculated as part of the lake water budget the flushing rate is 2.76 years. Therefore, on average, the water mass in Four Mile Lake changes approximately every 1000 days.

Water levels in the lake are not regulated, therefore are prone to natural fluctuations in the hydrological regime. Water levels tend to be highest in the lake during winter and early spring from spring snowmelt and tend to gradually decline through the summer as water inputs are reduced and evaporation is high. The tributaries entering Four Mile Lake also tend to exhibit well-defined seasonal flow patterns, more typical of a natural flow regime. High flows typically occur during early spring, associated with snowmelt, and throughout the year following high precipitation events. Low flows are usually observed in the summer and winter months.

Abundant wetlands and forested areas in the Four Mile Lake watershed provide significant benefits for surface water by moderating stream flow, providing high and low flow mitigation, and assisting in groundwater recharge.

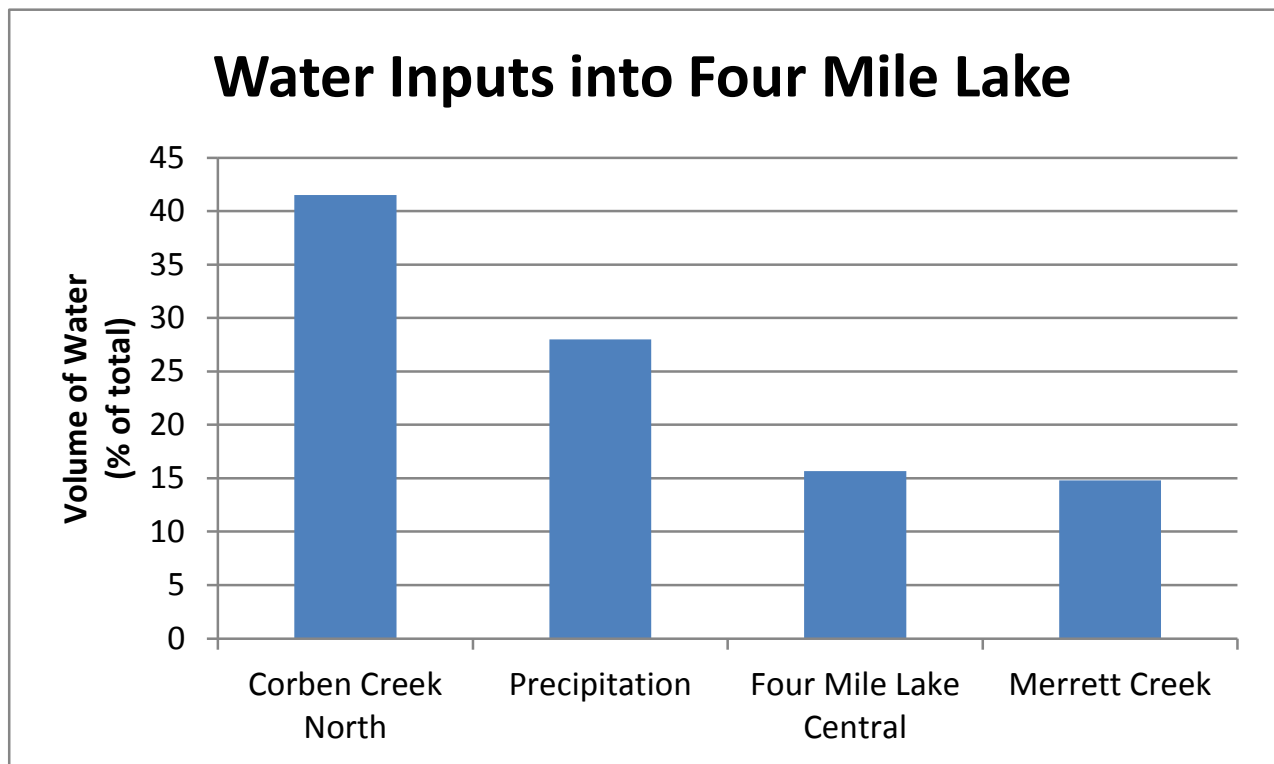


Figure 1.7: The major sources of water, by volume, entering Four Mile Lake on an average yearly basis (2013-2016)

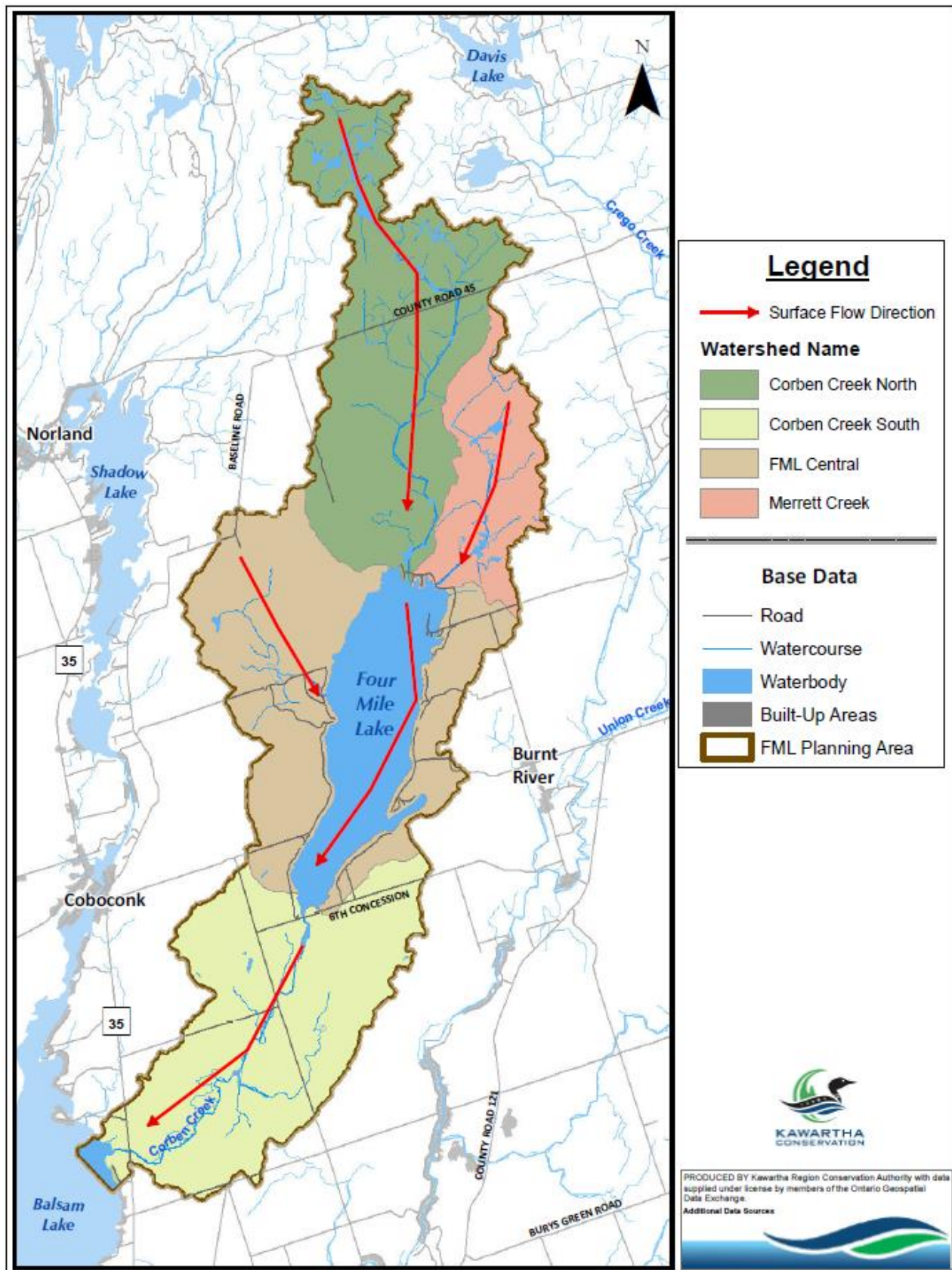


Figure 1.8: Major subwatersheds and their flow direction within the Four Mile Lake Planning area

1.5.3 Water Quality

The need to maintain excellent water quality conditions in Four Mile Lake is a major trigger for development of the *Four Mile Lake Management Plan*. Exceptional water quality is important to maintaining the environmental, economic, and socio-cultural benefits provided by the lake.

At present, Four Mile Lake is characterized as being an oligo-trophic (low productivity) water body with excellent water quality. According to the *Provincial Water Quality Objectives* (Ontario Ministry of Environment and Energy, 1994), to avoid nuisance concentrations of algae in lakes that are naturally low in productivity, the average total phosphorus concentrations for the ice-free period should not exceed 10 micrograms per litre (ug/L). As shown in Figure 1.10, phosphorus data has been collected on an annual basis since 2010 by local lake stewards through the Lake Partner Program (administered by the Ontario Ministry of Environment and Climate Change), and since 2014 by Kawartha Conservation. According to these data every year Four Mile Lake meets the provincial objective, and has been relatively stable over the past 15 years at approximately 5 ug/L and is in fact less than the 1971 recorded results of 12.1 and 12.0 µg/L (Michalski Associates, 1986).

Some lakes in the neighbouring Kawartha Lakes system (e.g., Sturgeon Lake) have shifted in the last 40 years from murky open-water dominated lakes with frequent algae blooms to clearer lakes with more abundant aquatic plants. This coincided with substantial decreases in nutrient concentrations, due in large part to phosphate reduction regulations and wastewater treatment improvements. Other processes have likely contributed to this apparent shift such as internal nutrient cycling, invasive species, and water temperature changes among others. Anecdotal information from local Four Mile Lake shoreline residents suggests that the introduction and subsequent proliferation of zebra mussels in the mid 1990's have led to clearer waters and increased abundance of aquatic plants. This claim is logical and likely but has not been substantiated with pre- and post-invasion water quality data.

Water quality within the tributaries draining into and out of Four Mile Lake is also considered to be in an excellent state. As stated in the *Provincial Water Quality Objectives* (Ontario Ministry of Environment and Energy, 1994), excessive plant growth in rivers and streams should not be evident at a total phosphorus concentration below 30 ug/L. As shown in Figure 1.11, according to recent water chemistry sampling, all watercourses have phosphorus concentrations that meet this objective. Merrett Creek is the only sampled watercourses that often has relatively high average phosphorus, nitrogen, and suspended sediment concentrations. Since this subwatershed is almost 100% natural lands, and thus no known sources of contamination are evident, high values in these water quality parameters is likely a natural occurrence.

Phosphorus Loading by Water Source

Another way of summarizing phosphorus information is to convert concentrations to loading amounts. Loading is the amount of phosphorus, by weight, that enters the lake on a yearly basis.

For Four Mile Lake, the phosphorus loading data from 2013 to 2016 indicate that approximately 468 kg of phosphorus enters the lake every year. The majority of phosphorus enters the lake during the spring, when elevated runoff caused by snowmelt and precipitation carries large quantities of nutrients into the lake. Figure 1.12 provides a breakdown of current phosphorus inputs into the lake by water input source. The categories represent inputs from the catchment areas identified in Figure 1.8 (except Corben Creek South, which drains out of, not into, the lake). The following provides a summary of current phosphorus loadings into Four Mile Lake each year by water source.

- Four Mile Lake Central subwatershed accounts for 39% (182 kg) of the total. This total includes loadings from the unnamed tributary (also known as Western Creek) that flows into west shore of Four Mile Lake, the estimated surface water runoff from the eastern lands flowing into the lake into the eastern shore, as well as all of the estimated inputs from shoreline septic systems around the lake.

- Atmospheric deposition accounts for 23% (107 kg) of the total. This category was measured from rain and snow sampling and includes inputs from wet deposition such as rain, snow, and dew, as well as from dry deposition from dust. Due to the large surface area of the lake compared with its upstream drainage areas, the contribution from atmospheric deposition is relatively high.
- Merrett Creek subwatershed accounts for 23% (107 kg) of the total. This value is relatively high compared to the other subwatersheds and is due to the relatively higher amounts of phosphorus concentrations within the creek even though its annual flow contribution to the lake is approximately 15%.
- Corben Creek North subwatershed accounts for 15% (71 kg) of the total. Although the total flow contribution to the lake from this source is relatively high (approximately 40%), phosphorus concentrations are relatively low.

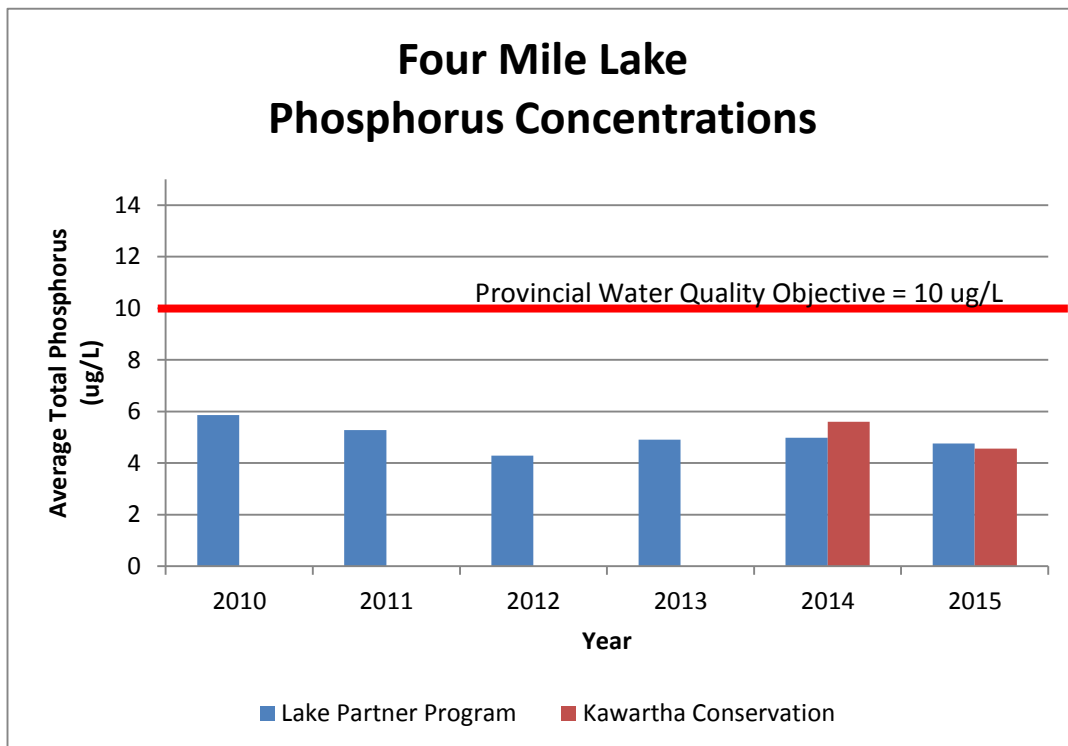


Figure 1.10: Average phosphorus concentrations (2010-2015) in Four Mile Lake during the ice-free period, in relation to provincial water quality objectives

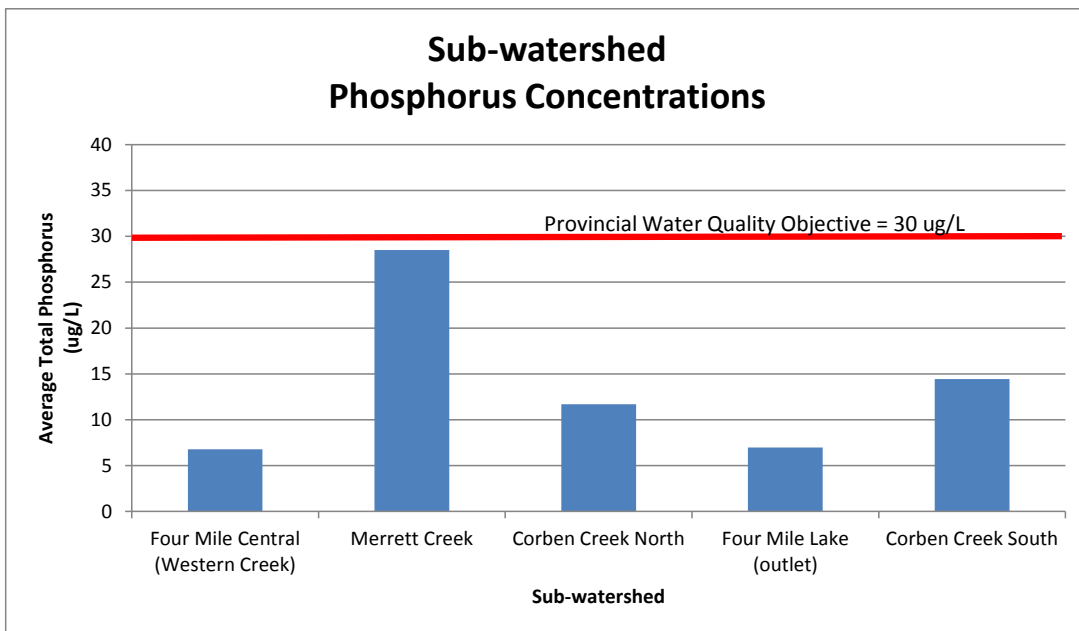


Figure 1.11: Average phosphorus concentrations (2013-2016) in subwatersheds draining into, and out of, Four Mile Lake, in relation to provincial water quality objectives

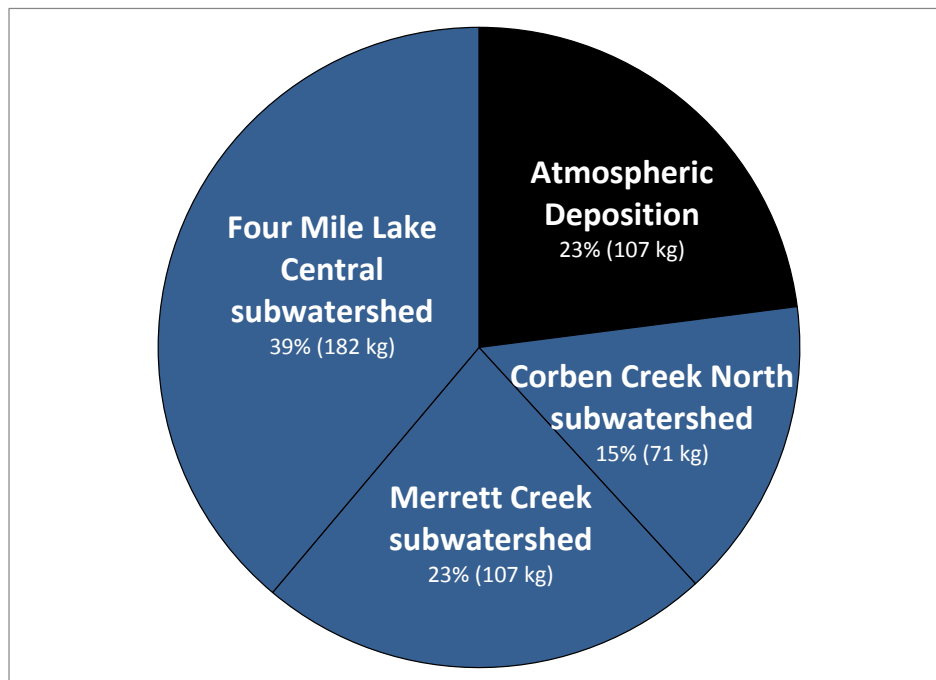


Figure 1.12: Average annual phosphorus loadings into Four Mile Lake, by major water source (2013-2016)

Phosphorus Loading by Sector

To determine the amount of phosphorus loadings into the lake by sector, inputs from all local subwatersheds of Merrett Creek, Corben Creek North, and Four Mile Lake Central (i.e., the blue pie slices of Figures 1.12) have been broken out into the estimated inputs generated from Natural Sources, Agricultural Runoff, Urban Runoff, and Shoreline Septic Systems. This approach assists in identifying human-derived sources of nutrients that could have management potential.

The following provides a summary of current phosphorus loadings into Four Mile Lake, by sector, in the three local subwatersheds that drain into the lake (Figure 1.13). These account for 77% (360 kg) of the total inputs into the lake from the subwatersheds of Merrett Creek, Corben Creek North, and Four Mile Lake Central water sources.

- Shoreline Septic Systems account for an estimated 29% (135 kg) of the total phosphorus entering Four Mile Lake. This value includes estimated inputs from systems (e.g., holding tanks, tile beds, etc.) in close proximity to the Four Mile Lake shoreline. There are approximately 409 residences with private septic systems within 75 m of the lake. To calculate phosphorus loading from septic systems, it was estimated that 50% of the phosphorus leaving each septic tank eventually reaches the lake. The phosphorus entering the lake from septic systems is of particular concern because it is orthophosphate, a form of phosphorus that is readily available for instantaneous algae growth.
- Natural Sources account for an estimated 33% (155 kg) of the total phosphorus entering Four Mile Lake. This source represents phosphorus that is deemed to enter the lake naturally (that is, without human origin) through stream and river flow within the core planning area. Examples of these inputs include wetlands and forests. Merrett Creek has a particularly high flow of natural sources of phosphorus.
- Urban Runoff accounts for an estimated 15% (69 kg) of the total phosphorus entering Four Mile Lake. This represents the phosphorus generated from developed areas around the lake shoreline and within its watershed that enters the lake through stream overland flow. Examples of phosphorus inputs from shoreline development and activities include lawn fertilizers and pet wastes.
- Agricultural Runoff accounts for an estimated 0.3% (1 kg) of the total phosphorus entering Four Mile Lake. This represents the farm-generated phosphorus estimated to come from crop lands (rare) and pasture fields (more common) that enters the lake through stream and river flow within the core planning area. Examples of these inputs include fertilizer applications, field erosion, and livestock manure.

Phosphorus Benchmarks

All subwatersheds have phosphorus concentrations that meet the *Provincial Water Quality Objectives* (Ontario Ministry of Environment and Energy, 1994). In striving to maintain, and where possible enhance, the existing healthy water quality conditions, there is a need to maintain or reduce these levels to buffer impacts from future cumulative pressures. Thus, management benchmarks have been developed for phosphorus loading amounts based on their estimated contributions by sector.

As illustrated, there are 4 major water sources that load phosphorus into Four Mile Lake: Atmospheric Deposition, Merrett Creek, Corben Creek North, and Four Mile Lake Central (Figure 1.12). Sector-specific benchmarks have been developed for the sources of phosphorus considered manageable within the Local Subwatersheds category. Atmospheric Deposition is excluded because it is considered an unmanageable source.

As shown in Figure 1.13, the Local Subwatershed category has been further broken down into four sector-specific phosphorus contributions: Natural Sources, Agricultural Runoff, Urban Runoff, and Shoreline Septic Systems. The sector-based benchmarks only apply to Agricultural Runoff, Urban Runoff, and Shoreline Septic Systems categories. These three sources are considered manageable, whereas Natural Sources are not.

Benchmarks for urban runoff were developed by estimating that the existing loading from developed areas could be reduced by approximately 15% with the uptake of lot-level water quality improvement practices. Estimates are based on current research (e.g., Steinman et al., 2015) that suggests that implementation of various best management practices such as infiltration swales, permeable pavement, and rain gardens can reduce phosphorus loading by approximately 15%. Benchmarks for shoreline septic systems were developed by estimating that approximately 5% of existing systems are "failing" (i.e., not functioning properly, which in the worst case equates to direct pollution into the lake). Estimates are based on recent septic inspection findings from lakes within Ontario (e.g., B.M. Ross Associates and Township of Huron-Kinloss, 2014) that suggest that approximately 5% of inspected septic systems were deemed to be either an environmental hazard or structurally unsafe. Therefore, the benchmark expresses how much reduction is needed to offset the "failing" loadings. Benchmarks for agricultural runoff were developed by estimating that the existing loading from farmlands could be reduced by approximately 25% with the uptake of water quality improvement practices. Estimates are based on current research (e.g., Makarewicz et al., 2015) that suggest that implementation of various best management practices such as grassed waterways, cover crops, and streambank stabilization can reduce phosphorus loading by approximately 25%.

- The overall phosphorus benchmark for Four Mile Lake is a maximum loading rate of approximately 450 kg per year. This equals a reduction of existing average annual phosphorous loadings by approximately 17 kg (minus 15% of current loading from manageable sources) from the subwatersheds that drain into Four Mile Lake (Table 1.5). Sector-specific phosphorus benchmarks are
 - 59 kg/year (minus 15% of current loading) or less, from Urban Runoff;
 - 0.75 kg/year (minus 25% of current loading) or less, from Agricultural Runoff; and
 - 128 kg/year (minus 5% of current loading) or less, from Shoreline Septic Systems.

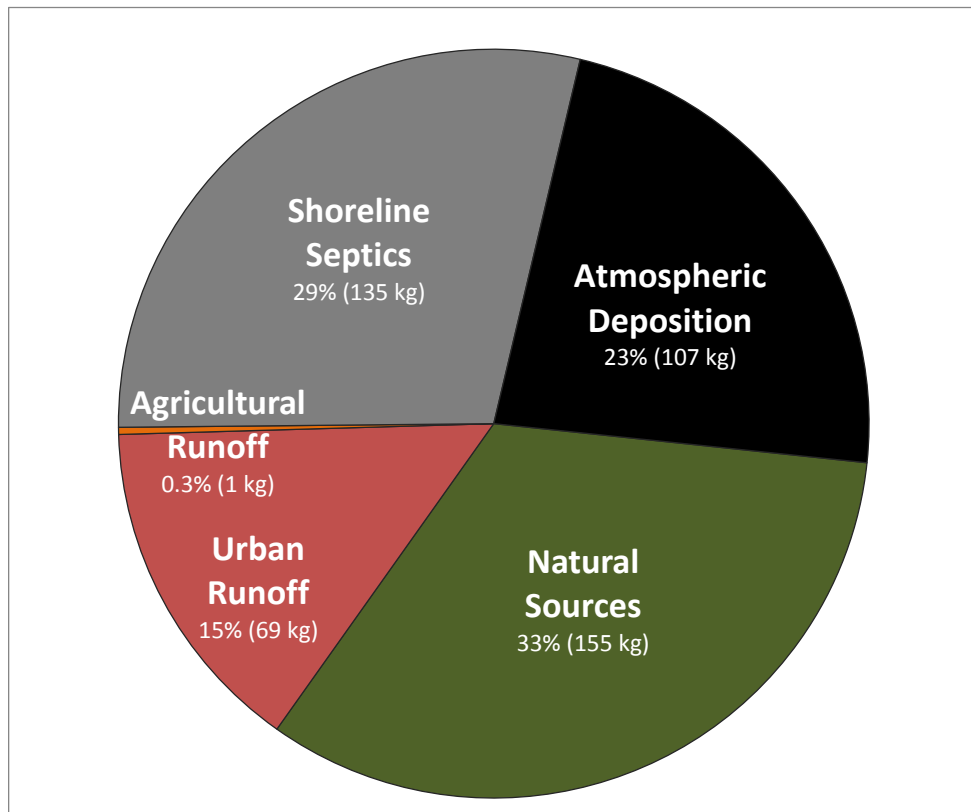


Figure 1.13: Average annual phosphorus loading into Four Mile Lake, by sector (2013-2016).

Table 1.5: Phosphorus benchmarks on a sector basis

Major Input Source	Existing Phosphorus Inputs (kg/year)	Benchmark Water Quality Objectives (kg/year)	Overall Reduction Needed (kg/year)
Urban Runoff	69	59	10 (15%)*
Agricultural Runoff	1	0.75	0.25 (25%)**
Shoreline Septic Systems	135	128	7 (5%)***
Subtotal: Manageable Sectors	205	188	17 (15%)
Natural Sources	155	155	0 (0%)****
Atmospheric Deposition	107	107	0 (0%)****
Total: All phosphorus inputs	468	450	-

*Benchmarks for urban runoff are based on recent research from other areas (e.g., Steinman et al., 2015) that suggests by implementing various best-management practices, it is reasonable to expect a 15% decrease in phosphorous inputs from shoreline development areas.

**Benchmarks for agricultural runoff are based on recent research from other areas (e.g., Makarewicz et al., 2015) that suggests by implementing various best-management practices, it is reasonable to expect a 25% decrease in phosphorus inputs from agricultural areas.

*** Benchmarks for shoreline septic systems are based on recent system inspection findings from lakes within Ontario (e.g., B.M. Ross Associates and Township of Huron-Kinloss, 2014) that suggests that approximately 5% of existing shoreline septic systems are considered high risk of failing (i.e., an environmental hazard or structurally unsafe), which equals approximately 7 kg per year of phosphorus going into Four Mile Lake. Therefore, a 5% reduction from existing loading values is needed to make up this difference.

**** Benchmarks for natural sources and atmospheric deposition are not applicable, and thus are not included in the overall reduction needed values.

1.5.4 Aquatic Ecosystems

Aquatic ecosystems refer to the water-related components that support life in and around Four Mile Lake. Healthy aquatic life provides significant benefits such as economic revenue (e.g., a high quality fishery that attracts anglers to the area), social significance (e.g., a picturesque cottage-country setting with abundant wildlife), and ecological integrity (e.g., a self-perpetuating food web). As our lake-based communities continue to grow, so does the pressures placed on its ecosystem. The cumulative effects of pressures such as incremental habitat loss, pollution, and introductions of non-native species can cause dramatic shifts in the lake food web. Responsible management is needed not just at a property level, but also in recognizing that life in lakes is dependent upon multiple components connected at a broader ecosystem level.

Due to the hydrological interconnectedness and close proximity of Four Mile Lake with the Kawartha Lakes, most aquatic life found in Four Mile Lake and their tributaries is found in the other Kawartha Lakes as well. However, there are many unique characteristics worth noting, particularly in fish communities and aquatic habitat conditions.

There are relatively limited long-term aquatic community data available for Four Mile Lake, given that it has not traditionally been routinely monitored through a standardized approach by any given agency or organization. Available fisheries data comes from five main sources: Ontario Ministry of Natural Resources and Forestry (sampling in the early-to-mid 1970's), Michalski Associates (sampling in the mid 1980's), Briones and Kelly (sampling in early 2000's), Kawartha Conservation (sampling in mid 2010's), and sporadic records submitted to Ontario Ministry of Natural Resources and Forestry over the years. This information helps to characterize the fish community and aquatic habitat conditions in the lake but does not permit the characterization of long-term changes.

According to available data, Four Mile Lake and its tributaries support a diverse fish community. Approximately 21 fish species have been documented in the planning area (Table 1.6). According to the most recent lake-netting programs (2009), the most large-bodied fish species found in Four Mile Lake, in terms of relative abundance, are yellow perch, smallmouth bass, rock bass, walleye, pumpkinseed, white sucker, largemouth bass, and muskellunge. No known fish species listed as Special Concern, Threatened, or Endangered have been documented.

Lake herring, lake whitefish, and burbot are all locally rare coldwater fish species that have been documented within the lake. These fishes require cold, well-oxygenated waters to support their populations. The southern basin of Four Mile Lake is the deepest part of the lake and has been observed to stratify during the summer months, trapping cold water in the deeper water that provides the habitat needed to sustain these fishes during the hot summer months. Temperature and dissolved oxygen profiles taken within the south basin from late spring to late summer indicate that there is sub-optimal quality for these species, particularly as the summer season progresses and water temperature increases and dissolved oxygen decreases. Data indicate that deep waters (below 9m in depth during late summer) have cold-enough temperatures to support coldwater life but dissolved oxygen concentrations are below their required threshold within these cold waters, the reason for which remains poorly understood. This was also documented in a previous study by Michalski Associates (1986), who noted this is a natural process even in undisturbed lakes. There are no indications that oxygen concentrations have significantly changed since then. In the spring and fall months, this basin experiences "turn-over" and temperatures again become uniform throughout the lake.

Four Mile Lake has an active recreational fishery supported particularly by smallmouth bass and walleye. Walleye are not native to Four Mile Lake (they were purposely introduced historically into several lakes in the region), however because they have been long-integrated into the lake ecosystem and because they are highly regarded as a sport fish, walleye are considered 'naturalized' to the lake and are not managed as an invasive species. Angling effort, harvest, and targeted species have not been recently quantified. In the Kawartha Lakes, the most sought-after species for anglers has shifted within the past 30 years, from predominately walleye to bass and walleye. Also during this time, fish harvested by anglers has shifted from walleye to bass and panfish. Muskellunge are sought after fish as well. In the absence of local data, it is reasonable to infer that these generalizations likely hold true for the fishery of Four Mile Lake.

Lake tributaries provide important ecological pathways to and from the lake. There are three main tributaries that drain directly into Four Mile Lake. Two of these, Merrett Creek and Corben Creek North, are low gradient watercourses that likely support spawning habitat of migratory fish in the lake. The unnamed creek that flows under Beaver Lane into the west shore of Four Mile Lake has been documented as providing walleye spawning habitat. Generally, there is unimpeded access along most lake-tributary pathways. Notable exceptions are a large beaver dam immediately upstream of Beaver Lane, and beaver grates on Merrett Creek at Woodworth Drive. Recent aquatic resource sampling on the main tributaries into and out of Four Mile Lake suggests that aquatic habitat conditions are of good quality. All sites had good representation of sensitive benthic macroinvertebrates (bottom-dwelling bugs) such as stoneflies, caddisflies, and mayflies.

Table 1.6: Fish species present or recorded historically in Four Mile Lake and connecting tributaries

Fish by Common Names		
Muskellunge	Yellow Perch	Blacknose Shiner
Smallmouth Bass	Brown Bullhead	Bluntnose Minnow
Largemouth Bass	White Sucker	Spottail Shiner
Walleye	Lake Whitefish	Iowa Darter
Lake Herring	Burbot	Fathead Minnow
Pumpkinseed	Emerald Shiner	Creek Chub
Rock Bass	Common Shiner	Central Mudminnow

Bold indicates important species to the recreational fishery

1.5.5 Terrestrial Natural Heritage

Four Mile Lake lies within an area known as “The Land Between,” a transitional zone between two distinct ecological units: the Canadian Shield and the St. Lawrence Lowlands. This overlap in area is significant on a provincial scale as it provides a unique concentration and diversity of natural heritage features that occur within both of these distinct land-form types.

Natural cover on the landscape (that is, forests, wetlands, meadows, and vegetative corridors along water courses and shorelines) is essential to maintaining healthy lakes and their watersheds. The services provided by these natural features include the following:

- Filter and utilize nutrients, absorbing sediments and other pollutants from surface water runoff.
- Improve air quality through filtration and oxygen release.
- Provide natural aesthetic vistas.
- Provide wildlife habitat, including habitat for species we are just starting to understand (e.g., a wide range of pollinators).
- Provide the first line of defense in flood attenuation by absorbing high water levels.
- Provide recreational opportunities such as hunting, hiking, and wildlife watching.
- Reduce shoreline erosion.
- Sequester carbon to reduce atmospheric carbon dioxide levels, thus contributing to the mitigation of the effects of climate change.
- Moderate summer temperature extremes through shade and transpiration.

Approximately 25% of the shoreline area around Four Mile Lake remains in a natural state, with forests being the dominant natural cover type. The subwatersheds, on the other hand, contain large tracts of natural lands. Most of this cover is upland forests, however Merrett Creek and Corben Creek North subwatershed have large tracts of treed wetlands (swamps). The protected and reforested areas including: Altberg Wildlife Reserve, Somerville Tract, and Victoria County Forest exist in the north east section of the planning area. These are popular recreational areas, particularly for hiking and nature viewing.

According to a research document titled *How Much Habitat is Enough?* (Environment Canada, 2013), a certain minimum amount of natural cover types are needed on the landscape to maintain healthy ecosystems. These benchmarks exist for forest, wetland, and streamside vegetation amounts. We can compare existing natural cover values in the core planning area against these benchmarks to provide insight into the condition of our terrestrial natural heritage. Table 1.7 provides a summary of management benchmarks calculated for each subwatershed and the core planning area. Where the existing natural cover level is below the benchmark, the additional cover required to meet the benchmark has been presented. Owing to the extensive areas of natural cover, the subwatersheds of Four Mile Lake meet all guidelines except for Corben Creek South and Four Mile Lake Central. However, the physical geography of these subwatersheds is naturally more conducive to dry natural lands (e.g., meadows, upland forests) due to the excellent drainage and karst (fractured limestone) pathways.

There are a number of locally significant areas of natural and scientific interest located in the Four Mile Lake watershed that have not been classified or identified by the province or Kawartha Conservation as regionally or provincially significant. These locally significant areas are an opportunity for further study, characterization, and potentially, inclusion into a natural heritage system. The Four Mile Lake planning area is known to provide natural habitat that supports the following locally or provincially rare wildlife species including:

- two bird species: eastern meadowlark and chimney swift;
- two turtle species: Blanding's turtle, and snapping turtle; and,
- two plant species: woodland pinedrops, and crested arrowhead.

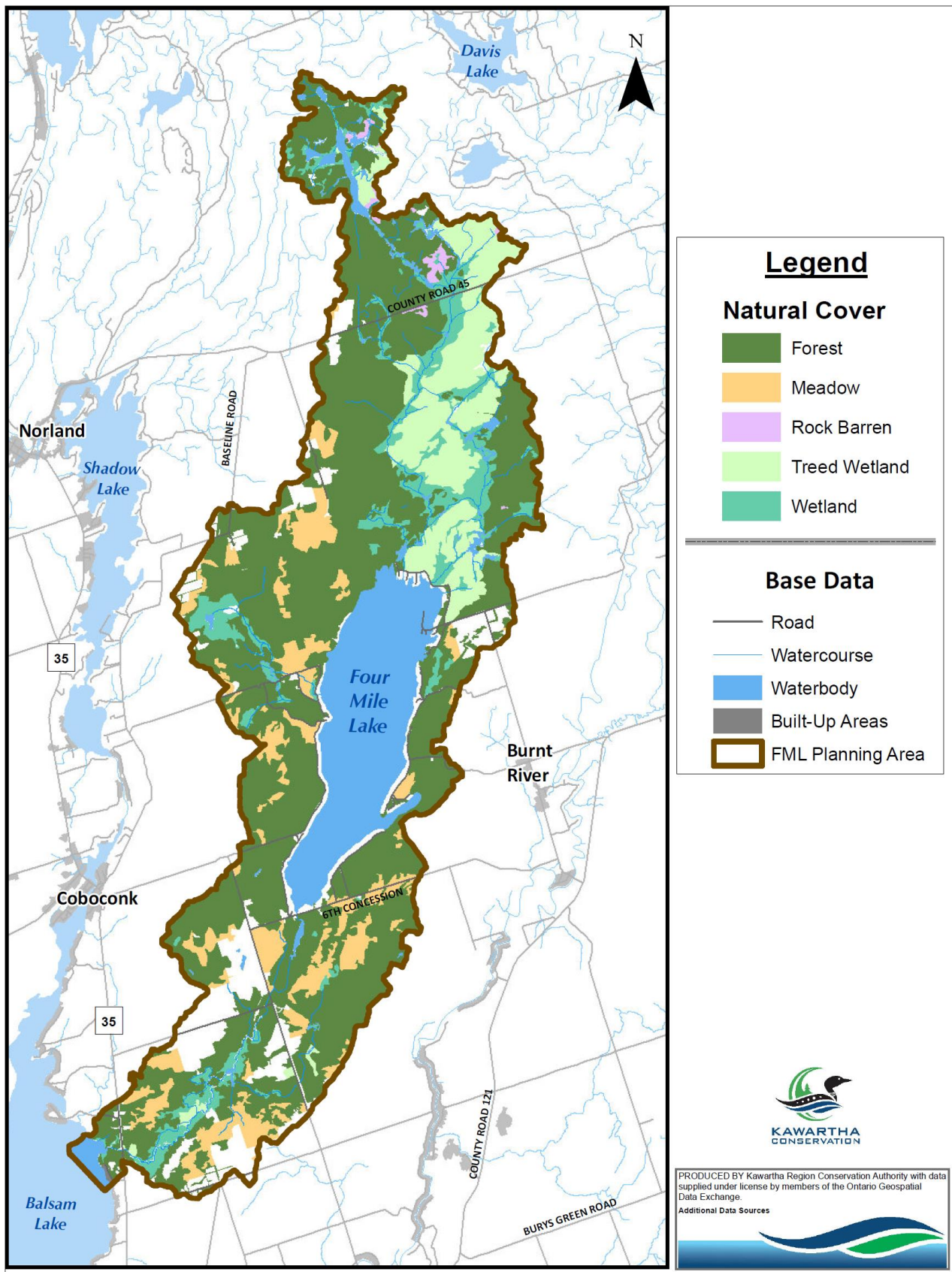


Figure 1.13: Map showing natural cover types within the Four Mile Lake Planning area

Table 1.7: Table summarizing existing forest, wetland, and streamside vegetation cover within the Four Mile Lake Planning area, in relation to ecosystem health benchmarks

Subwatershed	Forests Benchmark = >50%		Wetlands Benchmark = >10%		Streamside Vegetation Benchmark = >75%	
	Existing %	Needed % (ha)	Existing %	Needed % (ha)	Existing %	Needed % (ha)
Corben Creek North	77	-	31	-	96	-
Corben Creek South	55	-	6	4 (76)	95	-
Four Mile Lake Central	69	-	7	3 (60)	92	-
Merrett Creek	76	-	58	-	94	-
Total Four Mile Lake Planning Area	68%	-	19%	-	95%	-

Red highlight: existing amount does not meet benchmark

Green highlight: existing amount meets benchmark

2.0 Management Objectives



*Corben Creek South – Outlet of Four Mile Lake
(Somerville 6th Concession, July 2016)*

2.1 Introduction

This chapter provides a summary of the management objectives of the *Four Mile Lake Management Plan*. Objectives are "what we want to achieve" through a coordinated approach to managing the lake. The objectives form the basis of the Implementation Strategies and were developed through community consultation. Each management objective is organized into the following: Background, Issues, and Implementation Approach. There are four objectives in total.

Background provides a summary of the objective, including its origin and why it's important. Key points are highlighted, such as valued components, current state, and apparent trends that are relevant in implementing the *Four Mile Lake Management Plan*.

Issues are barriers that prevent us from realizing the objective. Issues have been identified by two means: (1) technical studies, science-based research, and anticipated relevance and (2) concerns expressed through the lake-stakeholder consultation process.

Implementation Approach is a summary of how we intend to address issues and fully realize our objectives. Actions are presented under each strategy in Chapter 3: Implementation Strategies. For specific details related to each action, please refer to Implementation Strategies.

Strategies

- **Stewardship:** Actions that are tailored to shoreline landowners and lake users to voluntarily undertake best management practices on their properties for the benefit of all and the future health of the lake
- **Strategic Planning:** Actions that give profile to pro-active land use policy and natural resource planning initiatives.
- **Urban and Rural Infrastructure:** Actions that focus on voluntarily maintaining sustainable public areas and construction works including lake-access areas, roads, and all construction sites.
- **Research and Monitoring:** Actions focused on addressing, through collaboration, science-based information gaps to better understand the response of the lake to emerging pressures, and tracking environmental health and plan effectiveness through time.
- **Communications and Outreach:** Actions that encourage dialogue and information-sharing among all stakeholders and promote sustainable practices to maintain healthy lake environments. In this chapter, there are no specific Communications and Outreach actions identified under each Management Objective because effective communication is crucial to implementing all aspects of the management plan. Please refer to the Communications and Outreach Strategy in Chapter 3 for all Communication and Outreach actions.

2.2 Management Objective #1:

Maintain excellent water quality conditions

BACKGROUND:

- Four Mile Lake has excellent water quality. There is overwhelming community support for maintaining excellent water quality conditions. Data collected over the last 15 years suggests that water is clear and clean and has remained relatively stable. Nutrient concentrations within the lake and all its major subwatersheds meet provincial water quality guidelines.
- Life in and around the lake needs clean water. Several lakeside residents draw water along shorelines for personal use, and thus need access to clean water. Aquatic ecosystems also need clean water to thrive. Excessive inputs of sewage, nutrients, sediments, toxic chemicals, and other elements can negatively impact the quality of the lake water for human use and ecosystem needs.

ISSUES:

- Pollutants from shoreline development and activities. The shoreline around Four Mile Lake is heavily developed, mostly by residential properties. These shoreline properties tend to contain significant amounts of hardened surfaces such as concrete, asphalt, and patio stones where pollutants (such as pet feces, oil, fertilizers, salt, etc.) accumulate. After a rain, these harmful substances tend to be washed directly into the lake instead of being purified by gradually filtering through vegetation into the ground. Furthermore, all shoreline properties are on private septic systems. Research suggests that in areas of shallow soil depths (as is the case along Four Mile Lake), there is a greater risk for leaching of contaminants into the lake if septic systems are not functioning optimally. High nutrient loadings into the nearshore can deteriorate water quality and lead to increased aquatic plant growth.
- Occasional posting of public beach as unsafe due to *E.coli*. The public space at the end of Hillside Drive is a popular swimming destination, and is routinely tested by the Haliburton Kawartha Pine Ridge District Health Unit to advise swimmers whether the beach is deemed safe for swimming at that particular time. If the water at the beach is found to contain high *E. coli* levels, it is considered potentially hazardous to human health and posted as "unsafe for swimming." Over the past five years the public beach has been posted as potentially unsafe for swimming at least once a year, due to elevated *E.coli* levels. The reason for high *E. coli* remains unclear but are likely the result of a combination of factors including feces from birds, stormwater runoff over developed areas containing contaminants following storm events and/or shallow, warm waters with limited water circulation.
- Potential contamination from other sources. The potential for oil and/or gas spills from power boats, oil spills from shoreline properties, and other disturbances are areas of concern for many local residents.

Implementation Recommendations (Objective #1):

Stewardship

- Undertake responsible management of septic systems, including routine inspections, along shoreline properties [Action A1 - page 45].
- Manage stormwater runoff by increasing the filtering and absorbing capacity of shoreline properties [Action A3 - page 47].
- Undertake responsible recreational boating within the lake, including routine equipment inspection and minimizing disturbance to sensitive habitats [Action A5 - page 49].

Strategic Planning

- Maintain Four Mile Lake as a Special Policy Area within the municipal Official Plan, and keep the existing applicable policies intact [Action B1 - page 51].
- Consider various regulatory options for preventing the clear-cutting of large forested areas along the shoreline [Action B2 – page 52].
- Protect large tracts of land that are ecologically and/or culturally significant [Action B4 – page 54].

Urban and Rural Infrastructure

- Maintain a safe and accessible public lake-access location through managing access to the boat launch and improving water quality at the beach [Action C1 – page 56].
- Ensure that construction projects, particularly road maintenance works, are conducted in a manner that does not degrade water quality or sensitive habitats [Action C2 – page 57].

Research and Monitoring

- Implement a coordinated lake monitoring program that regularly tracks key indicators of lake watershed health, including nutrients, aquatic vegetation, forest cover, fish communities, and oxygen levels [Action D1 – page 59].
- Conduct research to more accurately identify shoreline sources of nutrients and potential impacts to nearshore areas of the lake [Action D3 – page 61].

2.3 Management Objective #2:

Maintain the biodiversity of the lake ecosystem

BACKGROUND:

- Biodiversity is what sustains healthy aquatic and terrestrial ecosystems. It includes all varieties of life and all habitats of the lake and its subwatersheds. Biodiversity helps sustain the goods and services provided by the Four Mile Lake ecosystem, such as provisioning services (e.g., food and fresh water), regulating services (e.g., air quality regulation, erosion regulation, and pollination), and cultural services (e.g., educational values, inspiration, and sense of place). Native biodiversity, or life that is naturally occurring in an area, provides greater benefits to the lake ecosystem than non-native biodiversity. Four Mile Lake is located within a distinct ecoregion known as “The Land Between,” which is known for supporting high levels of biodiversity.

ISSUES:

- Proliferation of non-native invasive species. Even though Four Mile Lake is relatively isolated, and not part of the Trent-Severn Waterway boating corridor, it remains prone to the introduction and spread of non-native species. Several non-native species are well established in Four Mile Lake including zebra mussels, Eurasian water-milfoil, purple loosestrife, and rusty crayfish. More recently, the banded mystery snail, *Phragmites*, and spiny water flea have been documented. Invasive species have been demonstrated to impact native biodiversity in Ontario lakes, and can have the potential to cause lake-wide ecosystem changes (e.g., the clearing of the water column from zebra mussel filter-feeding results in a deeper sunlight penetration depth, which in turn results in an increase in aquatic plants).
- Species at risk. Within the planning area, there are several documented wildlife species that are considered at risk on a provincial level. The species that particularly rely on aquatic habitat for persistence in Four Mile Lake include Blanding’s turtle and snapping turtle. Major threats to these species include loss of habitat (e.g., removal of nearshore vegetation), increased disturbance from development activities, direct mortality and injury by road vehicles and boat propellers.

Implementation Recommendations (Objective #2):

Stewardship

- Undertake measures to reduce the risk of transferring aquatic and terrestrial invasive species into the lake and its watershed [Action A2 – page 46].
- Maintain the natural features along the shoreline [Action A4 – page 48].
- Undertake responsible recreational boating within the lake, including routine equipment inspection and minimizing disturbance to sensitive habitats [Action A5 – page 49].

Strategic Planning

- Maintain Four Mile Lake as a Special Policy Area within the municipal Official Plan, and keep the existing applicable policies intact [Action B1 – page 51].
- Consider various regulatory options for preventing the clear-cutting of large forested areas along the shoreline [Action B2 – page 52].
- Undertake actions within the *Fisheries Management Plan for Fisheries Management Zone 17* on Four Mile Lake [Action B3 – page 53].
- Protect large tracts of land that are ecologically and/or culturally significant [Action B4 – page 54].

Research and Monitoring

- Implement a coordinated lake monitoring program that regularly tracks key indicators of lake watershed health, including nutrients, aquatic vegetation, forest cover, fish communities, and oxygen levels [Action D1 – page 59].
- Conduct research to identify how the lake ecosystem responds to stressors such as cumulative development, climate change, and invasive species [Action D4 – page 62].

2.4 Management Objective #3:

Enhance the natural integrity of the shoreline

BACKGROUND:

- The zone between land and water is often referred to as the 'Ribbon of Life'. Shoreline areas are extremely rich in biodiversity and provide multiple benefits to the lake ecosystem including filtering contaminants, preventing erosion, and providing fish and wildlife habitat. The shoreline around Four Mile Lake is approximately 21 km and contains significant residential development.
- The lake shoreline is a dynamic system. Natural forces such as water currents, wave action, and ice movement can be a source of shoreline accumulation (e.g., gaining land) or shoreline erosion (e.g., losing land). A natural shoreline provides a stable waterfront in most instances, due to its ability to stabilize soil, absorb wave energy, and slow lot-level surface water runoff. Shoreline degradation is often accelerated by waterfront modifications such as removal of natural cover, hardening, infilling, and dredging.

ISSUES:

- Significant residential development along the lake shoreline. The shoreline of Four Mile Lake is heavily developed, mostly consisting of individual residential or cottage properties that occupy approximately 73% of land area adjacent to the lake. Developed shorelines can cause reduced aquatic habitat potential, less water quality buffering capacity, greater wave action, land/water isolation, and other negative implications for the lake.
- Loss and fragmentation of aquatic habitat along the shoreline. The land/water interface along the shoreline, as well as shallow nearshore areas (less than 2m deep) are particularly prone to alterations from development and other activities associated within shoreline living. Aquatic habitat disturbance is evident in the developed areas along Four Mile Lake, including the removal of in-water logs and rocks, lack of mature overhanging vegetation, removal of wetland plants, and artificial structures (e.g., concrete, armourstone, steel, etc.) that isolate the land from the water. Data from a recent shoreline survey indicate that approximately 8% (1.8 km) of the land/water interface along the entire shoreline consists of artificial materials.

Implementation Recommendations (Objective #3):

Stewardship

- Undertake responsible management of septic systems, including routine inspections, along shoreline properties [Action A1 – page 45].
- Manage stormwater runoff by increasing the filtering and absorbing capacity of shoreline properties [Action A3 – page 47].
- Maintain the natural features along the shoreline [Action A4 – page 48].
- Undertake responsible recreational boating within the lake, including routine equipment inspection and minimizing disturbance to sensitive habitats [Action A5 – page 49].

Strategic Planning

- Maintain Four Mile Lake as a Special Policy Area within the municipal Official Plan, and keep the existing applicable policies intact [Action B1 – page 51].
- Consider various regulatory options for preventing the clear-cutting of large forested areas along the shoreline [Action B2 – page 52].

Research and Monitoring

- Implement a coordinated lake monitoring program that regularly tracks key indicators of lake watershed health, including nutrients, aquatic vegetation, forest cover, fish communities, and oxygen levels [Action D1 – page 59].
- Conduct research to identify how the lake ecosystem responds to stressors such as cumulative development, climate change, and invasive species [Action D4 – page 62].

2.5 Management Objective #4:

Improve our understanding of how the lake will respond to emerging pressures

BACKGROUND:

- Solid scientific understanding of lake-based pressures and how the lake ecosystem will respond to them are key elements in directing management decisions. Some of the important emerging pressures include:
 - Climate change. It is generally agreed that climate change is predicted to increase water temperatures and alter natural hydrological processes (e.g., more extreme weather events and changes to rainfall patterns). This will likely have impacts on multiple facets of the lake ecosystem including water quality, aquatic ecosystems including aquatic plant growth, and water levels and flows.
 - Cumulative development. It is unknown at what point development in the watershed/shoreline can cause serious negative implications for the lake aquatic ecosystem. Shoreline areas, in particular, are at risk of increased development and urbanization. There is a need to improve scientific understanding about the interactions of these stressors within the lake to better manage the resource.
 - Non-point sources of pollution. These are diffuse sources of pollution that are not easily measured because there is no single "outlet." A particular area of focus should be quantifying nutrient inputs into the nearshore areas of the lake (e.g., from septic systems, and shoreline development and activities) because these values are not well understood at this time.
 - Invasive species. Species introductions into areas outside their naturally occurring range can have profound impacts on lake dynamics. Zebra mussel proliferation in the Kawartha Lakes—resulting in increasing water clarity and leading to the proliferation of aquatic plants—is an example of the ecosystem-level impact of invasive species.

ISSUES:

- Lack of coordination of research and monitoring initiatives, and information management. Many different organizations and agencies are actively collecting data on various aspects of the lake ecosystem, including: volunteers implementing the Lake Partner Program (administered by the Ontario Ministry of Environment and Climate Change), Haliburton Kawartha Pine Ridge District Health Unit, Kawartha Conservation, City of Kawartha Lakes, Ontario Ministry of Natural Resources and Forestry, among others. At this time, there is no coordinated approach to these efforts, and there is no collective information management system in place.

Implementation Recommendations (Objective #4):

Research and Monitoring

- Implement a coordinated lake monitoring program that regularly tracks key indicators of lake watershed health, including nutrients, aquatic vegetation, forest cover, fish communities, and oxygen levels [*Action D1 – page 59*].
- Conduct research on aquatic plant distribution, composition, and their ecological and cultural significance to better inform lake management approaches [*Action D2 – page 60*].
- Conduct research to more accurately identify shoreline sources of nutrients and potential impacts to nearshore areas of the lake [*Action D3 – page 61*].
- Conduct research to identify how the lake ecosystem responds to stressors such as cumulative development, climate change, and invasive species [*Action D4 – page 62*].

3.0 Implementation Strategies



A loon nesting platform, an example of a wildlife enhancement project
(Four Mile Lake, east shore, August 2016)

3.1 Introduction

The following Implementation Strategies provide a framework for a coordinated approach to maintaining a healthy Four Mile Lake. Integrated efforts are fundamental to improving the environment in and around the lake. Everyone in the watershed shares a responsibility for the current state of the lake, so everyone is needed to participate in management efforts. A broad spectrum of partners and residents are encouraged to voluntarily undertake actions for the benefit of the lake. Working simultaneously, they can accomplish tasks in different areas. The more actions and strategies accomplished, the more likely that the objectives for a healthy lake environment will be met.

Implementation Strategies provide a suite of actions to help achieve the management objectives outlined in the previous chapter. For greater on-the-ground applicability, actions are presented under the following strategies:

- Stewardship Strategy,
- Strategic Planning Strategy,
- Urban and Rural Infrastructure Strategy,
- Research and Monitoring Strategy, and
- Communications and Outreach Strategy.

Within each strategy, an introductory context is provided for approaches to implementation along with detailed actions. The format for each management action is as follows:

Action: A brief description of the recommended management approach.

Priority: The level of priority for undertaking the particular action. A value was assigned for each action based on the five criteria listed below, and it was averaged to determine the overall priority level for the action. Please refer to Appendix C for more detail.

CRITERIA	Level	Value	Details
#1. Action meets multiple objectives?	High	3	Meets many (over half of) objectives
	Medium	2	Meets a few objectives
	Low	1	Meets a single objective
#2. Action is affordable?	High	3	Cost < \$5,000; easy to acquire local funding
	Medium	2	Cost >\$5,000 and <\$50,000; typical medium project proposal
	Low	1	Cost >\$50,000; must acquire significant funding
#3. Action has support from community?	High	3	Overwhelming support
	Medium	2	Majority support
	Low	1	Localized support
#4. Action builds public support for implementation?	High	3	High profile; includes a large number of stakeholders
	Medium	2	Medium profile; includes a medium number of stakeholders
	Low	1	Low profile; includes a small number of stakeholders
#5. Action has timely environmental benefit?	High	3	Short term (5 years or less) improvement
	Medium	2	Long term (5 years or more) improvement
	Low	1	Maintain status quo

Rationale: A description of why the action is important and how it supports the level of priority.

Priority Areas: A description of where the action is needed the most. It is most often geography based (e.g., specific subwatersheds or areas of the lake), but it is also based on other contexts (e.g., a specific threat).

Lead and (Partner) Implementers: Organizations, groups, or individuals who have been identified during the planning process as potentially leading or partnering in the implementation of actions. Partners are in parentheses.

Initiatives: A description of specific details and/or project measurables leading to successful implementation of an action. In some cases, a specific numeric target is identified.

3.2 Stewardship Strategy

Stewardship refers to the voluntary care of resources. In the context of this strategy, stewardship refers to the voluntary care by lakeshore property owners and lake users in a collective effort to meet the goals and objectives of the *Four Mile Lake Management Plan*.

We must all understand that our individual actions contribute to a collective impact on the health of the lake and its watershed. With this knowledge, associated shoreline and lake users can take actions that contribute to sustaining the health of this valuable resource.

The actions outlined in this strategy contribute to maintaining excellent water quality and enhancing natural habitats. Emphasis is on privately-owned shoreline property, with a primary focus of creating awareness about effective land and water stewardship practices. A second major focus is to provide technical assistance and other resources to private landowners in order to initiate positive stewardship actions.

The Stewardship Strategy works in conjunction with the Communications and Outreach Strategy.



Location of Walleye spawning shoal rehabilitation site, outlet of Four Mile Lake
(Work conducted in late 1970's, Somerville 6th Concession, May 2015)

Action A1: Septic system maintenance

Undertake responsible management of septic systems, including routine inspections, along shoreline properties.

Priority

- High

Rationale

- Septic systems at shoreline residences on the strip of land around the lake are estimated to contribute almost one-third (29%) of the phosphorus load from all sources. This is the largest manageable source of phosphorus that enters the lake. A 5% reduction in septic system loading is needed to achieve the water quality benchmarks for the lake. This source of phosphorus has a potentially significant influence on nearshore water quality and aquatic plant proliferation, because it is readily available for uptake (orthophosphate). In addition, bacteria from sewage is often ineffectively treated or contained by faulty septic systems. Human health should be a major consideration when faulty systems are in the vicinity of residential wells and swimming areas. Individual septic systems should be responsibly maintained.

Priority areas

- Densely populated shoreline areas; older septic systems
- Septic systems in close proximity to the public beach

Lead and (partner) implementers

- Four Mile Lake residents; City of Kawartha Lakes; Haliburton, Kawartha, Pine Ridge District Health Unit; (Four Mile Lake Association; septic system businesses; Federation of Ontario Cottagers' Associations)

Initiatives

- Encourage property owners to conduct periodic inspections of septic system to determine if functioning as designed or if pump-outs, repairs, or replacement is needed.
- Require septic system to be inspected (i.e., as formal conditions from real estate agents, lawyers, etc.) by a licenced installer as a condition of property sale/purchase."
- Conduct regular pump-outs, every 3 to 5 years depending on use or when scum and sludge occupy more than one-third of capacity, to ensure septic system is functioning as designed.
- Take advantage, if necessary, of the recently approved City of Kawartha Lakes "Septic Rehabilitation Loan Program." This allows owners to enter into a longer-term payback agreement to access funds to repair or improve their system.
- Host periodic "dock talk" extension services and local workshops with a focus on helping homeowners understand, inspect, and manage septic systems.
- Create a comprehensive inventory of all septic systems around Four Mile Lake, detailing type, location, year of construction, and other information.
- Continue investigating official complaints of potentially malfunctioning systems to address potential health hazards and determine corrective actions as required.
- Consider the feasibility of expanding the City of Kawartha Lakes Mandatory Maintenance Sewage System Program to include Four Mile Lake. This inspection program is intended identify systems that aren't being properly maintained and to provide education to home owners to ensure that on-site sewage systems do not cause a public health threat or environmental concerns. Currently this program only applies to wastewater systems on properties located within vulnerable areas of municipal drinking water systems.

Action A2: Invasive species management

Undertake measures to reduce the risk of transferring aquatic and terrestrial invasive species into the lake and its watershed.

Priority

- High

Rationale

- The introduction and spread of non-native species throughout the aquatic and terrestrial environment is generating profound implications for ecosystem health throughout North America. Several “invasive species” have established populations within Four Mile Lake ecosystem already (e.g., zebra mussels, Eurasian water milfoil), and are near impossible to eradicate once established to the detriment of biodiversity and lake-based values. Due to its hydrological connection and close proximity to popular Kawartha Lakes, and intense shoreline usage, Four Mile Lake is susceptible to the introduction and spread of more aquatic species (e.g., round goby, *Phragmites*) and terrestrial species (e.g., emerald ash borer, dog strangling vine). Probable pathways for spreading are through recreational activities (e.g., boating, hiking).

Priority areas:

- Vessels and in-water equipment that travels to and from Four Mile Lake
- Public boat launch
- Hiking trails, Somerville Tract, Altberg Wildlife Reserve, Victoria County Forest, Rail Trail

Lead and (partner) implementers

- Watershed residents; Invading Species Awareness Program - Ontario Ministry of Natural Resources and Forestry and Ontario Federation of Anglers and Hunters; (Federation of Ontario Cottagers’ Associations; Four Mile Lake Association; recreational boaters and anglers; City of Kawartha Lakes; Ontario Nature; Kawartha Field Naturalists; Ontario Invasive Plants Council; Kawartha Conservation; construction industry)

Initiatives

- Implement best management practices to reduce the risk of introducing and spreading invasive species, for example:
 - Inspect boats, trailers, boating equipment, fishing tackle and nets, and remove any visible plants or animals before leaving any water body.
 - Drain water from the motor, live well, and bilge and transom wells while on land, before leaving the water body.
 - Empty bait buckets on land before leaving the water body; avoid releasing live bait into a water body or transferring from one water body into another.
 - Wash and dry fishing tackle, nets, boat, and equipment to kill harmful species that may not be visible to the eye.
- Consider the feasibility of installing a voluntary boat and trailer wash station near the public boat launch. Appropriate runoff controls should be put in place at wash stations to prevent entry of potential exotic species into the lake.
- Report invasive species sightings through the Invading Species Hotline: 1-800-563-7711 and/or the Early Detection and Distribution Mapping System (EDD MapS Ontario): www.eddmaps.org/ontario
- Promote the use of existing “monitoring tool-kits” (e.g., <https://foca.on.ca/ais-monitoring-toolkit/>) to facilitate public education, with an emphasis to:
 - Learn how to prevent the spread of invasive species.
 - Learn how to identify existing invasive species and species that could potentially threaten watershed health.
 - Access information from organizations such as the Invading Species Awareness Program and the Invasive Plants Council to gain access and disseminate information to lake stakeholders.
 - Use best-bet control and management approaches.
- Host workshops and develop factsheets on emerging invasive species (e.g., emerald ash borer, *Phragmites*, etc.).
- Continue to regulate access to the public boat launch to limit amount of outsider boat activity.

Action A3: Stormwater runoff management

Manage stormwater runoff by increasing the filtering and absorbing capacity of shoreline properties.

Priority

- Medium

Rationale

- Although developed areas only account for approximately 4% of the Four Mile Lake planning area, they are concentrated along the shoreline. Almost three quarters of the shoreline length has been developed within 30m of the lake. These areas contribute disproportionately high amounts of sediments, nutrients, and other contaminants typically through increased surface water runoff over fertilized lawns and hardened surfaces (e.g., concrete, pavement, etc.) running into the lake. In terms of phosphorus loading into the lake, it is estimated that surface water runoff that flows over developed shoreline areas contribute 15% from all sources.

Priority areas

- Areas of dense urban shoreline development (e.g., western, eastern, southern shore of lake)

Lead and (partner) implementers

- Four Mile Lake residents; (Four Mile Lake Association; City of Kawartha Lakes; Kawartha Conservation)

Initiatives

- Develop a program that provides educational and project management assistance, as well as financial assistance where possible, to waterfront residents to support the uptake of lot-level measures for water stewardship action including:
 - Maintain a buffer strip of natural vegetation along urban waterfronts and stream banks to filter runoff, prevent erosion, and provide wildlife habitat.
 - Capture and store and diffuse storm runoff via rain barrels, grassed swales, vegetated depressions, rain gardens, splash blocks or “roll up” attachments to downspouts, and private stormwater management ponds as applicable.
 - Maintain trees and other landscape plants that help slow surface water runoff and reduce soil erosion; encourage the replacement of at-risk, dying, or storm-damaged trees with trees and shrubs of native species.
 - Mow lawns to no less than three inches in height to encourage healthier root development and help absorb more moisture.
 - Transition to the use of a low-or zero-phosphorus fertilizer or to the reduction and elimination of chemical fertilizers on lawns. Instead leave mulched clippings to decompose and use yard compost for soil amendments; do not discard of clippings in waterways.
 - Encourage soil testing to determine actual nutrient deficiencies, and adjust soil amendments accordingly.
 - Maintain permeable surfaces, such as porous asphalt or vegetated swales, as alternatives to hardened driveways, walkways, and parking lots.
 - Dispose of pet wastes in the garbage and discourage feeding of waterfowl.

Action A4: Naturalization along shorelines

Maintain the natural features along the shoreline.

Priority

- Medium

Rationale

- Shorelines are transitional areas from water to land, and are often referred to as the 'Ribbon of Life' around a lake because they are the most important areas in lakes for fish and wildlife production. Within the Four Mile Lake Planning Area, development is concentrated along the shoreline through mostly single residential lots, and as such this area around the lake is particularly vulnerable to human disturbance. At present approximately 8% of the shoreline, or 1.8km, has been modified into artificial structures (e.g., concrete, armourstone, manicured lawn, etc.) that do not provide optimum fish and wildlife habitat nor the runoff filtering capacity that are otherwise provided by natural features (e.g., trees, rocks, stumps, aquatic plants, etc.). There are numerous opportunities along existing waterfront properties as well as during property upgrade developments to maintain or increase fish and wildlife habitat.

Priority areas

- Areas immediately adjacent to the shoreline along residential properties

Lead and (partner) implementers

- Four Mile Lake residents; (Ontario Ministry of Natural Resources and Forestry; Four Mile Lake Association; Federation of Ontario Cottagers' Associations; Kawartha Conservation; City of Kawartha Lakes; local nurseries)

Initiatives

- Provide more education and marketing to shoreline residents on what to consider when undertaking shoreline improvements (i.e., who to contact for support, what options are available, etc.) that protect or enhance the integrity of the shoreline including:
 - Maintain a buffer strip of natural vegetation along the shoreline, the wider the better; establish a "no-mow" zone along the shoreline.
 - Minimize waterfront development of artificial structures (excluding erosion protection) to 25% or less of total frontage.
 - Select dock or boathouses sites where the least amount of vegetation currently exists, keeping safety in mind at all times.
 - Re-vegetate disturbed soil areas as soon as possible to stabilize loose soils.
 - Retain fallen trees and large rocks in the nearshore zone, unless they are a hazard to boats or swimmers.
- Produce and distribute a non-technical guidance document that clearly illustrates practical approaches for improving existing non-natural shorelines.

Action A5: Responsible boating

Undertake responsible recreational boating within the lake, including routine equipment inspection and minimizing disturbance to sensitive habitats.

Priority

- Medium

Rationale

- Four Mile Lake is an important body of water for recreation, particularly for private pleasure craft. Due to the potential for lake contamination by chemicals (e.g., gas, oil, etc.), there is a need to educate people about properly maintaining equipment and what actions to take in an emergency spill situation. Further, there are several areas of the lake (e.g., marsh wetlands, etc.) where boating disturbance should be avoided during periods of increased sensitivity (e.g., fish spawning and bird nesting areas).

Priority areas

- Sensitive shoreline habitats (e.g., marsh wetlands, fish spawning habitats)

Lead and (partner) implementers

- Recreational boaters; (Four Mile Lake residents; Four Mile Lake Association; Boating Ontario)

Initiatives

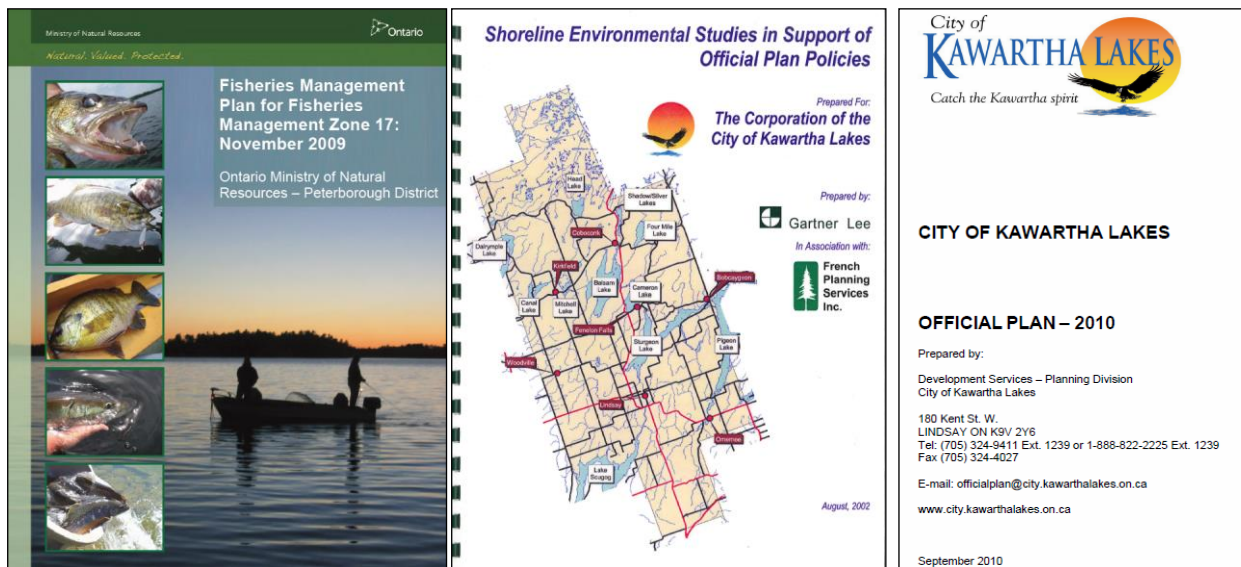
- Implement a Clean Boater campaign, to ensure a proactive approach to reducing risk of water contamination, through measures such as the following:
 - Practise preventative maintenance, including regular engine and equipment inspection and servicing.
 - Keep oil absorbent pads and containment pans or trays under the engine when it is not in water.
 - Know the fuel capacity prior to filling tanks; when possible, fill away from water over a spill containment system.
 - Store petroleum products carefully to reduce risk of spillage.
 - Minimize the use of harsh cleaners by rinsing boats regularly, or if a boat needs cleaning beyond the soft cleaning, first remove the boat from the water.
 - Whenever possible, use low-impact recreational practices (e.g., canoeing, kayaking, sailing, etc.) and technologies.
- Minimize disturbance to sensitive ecological features with measures such as the following:
 - Reduce your wake and ensure the boat is an appropriate distance from shore; this minimizes the turbidity (soil and sediment disturbance) and damage to nearshore areas.
- Minimize noise and speed levels when operating near populated waterfront areas.

3.3 Strategic Planning Strategy

The primary focus of this strategy is to undertake proactive approaches for lake health and environmental protection measures within land use policy and natural resource planning.

The existing municipal regulatory tools that apply to lands within the Four Mile Lake planning area, in particular the Four Mile Lake Special Policy Area designation within the City of Kawartha Lakes Official Plan, provides more stringent rules for new shoreline development than most other lakes within the municipality. One area of enhancement to the municipal planning approach is to explore mechanisms through which the large-scale removal of shoreline forested areas can be regulated.

Strategic natural resources planning and management is also emphasized within this strategy, through profiling the several actions within the Fisheries Management Plan for Fisheries Zone 17 and recognizing the importance of protecting large tracts of natural areas such as the Altberg Nature Reserve and the Victoria County Forest (Somerville Tract).



Examples of recently developed planning initiatives that contribute to the objectives of the Four Mile Lake Management Plan

Action B1: Maintain the Four Mile Lake Special Policy Area

Maintain Four Mile Lake as a Special Policy Area within the municipal Official Plan, and keep the existing applicable policies intact.

Priority

- High

Rationale

- Municipal Official Plans provide the structure for land use planning and development in the Four Mile Lake planning area. In the current Official Plan for City of Kawartha Lakes Four Mile Lake is stated as being sensitive to further shoreline development and as such there exists a special policy area schedule that provides enhanced water quality protection measures to areas within 300m along the shoreline and within the Corben Creek watershed. Shoreline residents have expressed their desire to maintain the existing policies with the Four Mile Lake Special Policy Area and are satisfied at this time with the regulatory balance that it achieves.

Priority areas:

- Four Mile Lake Special Policy Area within City of Kawartha Lakes Official Plan (lands within 300m around the lake; Corben Creek Watershed)

Lead and (partner) implementers

- City of Kawartha Lakes

Initiatives

- Maintain the existing policies within the Four Mile Lake Special Policy Area contained within the City of Kawartha Lakes Official Plan, in particular:
 - The following permitted uses: single family residential dwellings, and accessory uses and structures, and existing commercial, rural and industrial uses.
 - All new shoreline residential lots shall require a minimum lot frontage of 60 metres and a lot area of 0.4 hectares.
 - New shoreline residential development shall only be in the form of single family dwellings on separate lots that directly front on Four Mile Lake.
 - New residential cluster developments on the shoreline will not be permitted.
 - New single family residential dwellings will be permitted on backlots (i.e., lands with no lake frontage) on existing lots of record that have a minimum lot frontage of 60 metres on a publicly maintained road and have a lot area of 0.4 hectares.
 - All development shall have a minimum setback from the road of 30 metres.
 - New backlots may not be created except to separate two existing residential dwellings.
 - Residential cluster development on backlots with access to the lake through private or publicly owned lands will not be permitted.
 - Development within the Corben Creek Watershed:
 - no aggregate/quarrying development within 1000 m of Four Mile Lake (Refer to Schedule SP-1).
 - aggregate/quarrying sites outside of this 1000 m area will require specific site rehabilitation as required under the Aggregate Resources Act and an Environmental Assessment Report to ensure no direct or indirect impacts on Four Mile Lake's natural, social and physical character.
- Maintain the existing municipal bylaw that governs access to the public beach/boat launch; boats may only be launched or landed as follows:
 - Beginning the Friday before July 1st holiday: between 7-9am and 6-9:30pm.
Beginning August 1st to the Friday before Labour Day: between 7-9am and 12 to 1:30pm and 6-9:30pm

Action B2: Prevent the clear-cutting of forests along the shoreline

Consider various regulatory options for preventing the clear-cutting of large forested areas along the shoreline.

Priority

- Medium

Rationale

- Forested areas along the lake shoreline maintain the integrity of the lake ecosystem by stabilizing soils, moderating temperature, providing fish and wildlife habitat, reducing surface water runoff, and utilizing nutrients. The intent of this action is to prevent the clear-cutting of large tracts of forested areas along shoreline prior to a development application. The act of "cutting down" numerous trees is not typically considered development; therefore this practice does not trigger any land use policy if undertaken prior to the submission of a development application.

Priority areas

- Large forested areas (size and location to be determined through consultation) along the Four Mile Lake shoreline

Lead and (partner) implementers

- City of Kawartha Lakes

Initiatives

- Review various regulatory approaches to preventing the clear-cutting of large forested areas along the Four Mile Lake shoreline. The scope and criteria of the by-law (e.g., to which projects it applies) would be determined through the municipal process, which should emphasize public consultation. Potential tools to consider include:
 - Official Plan policies;
 - Municipal bylaws (e.g., Forest Conservation, Site Alteration, etc.);
 - Shoreline Secondary Planning; and,
 - Other regulatory approaches.
- Review and integrate where applicable guidance from the document Shoreline Environmental Studies in Support of Official Plan Policies for the City of Kawartha Lakes (Gartner Lee and French Planning Services, 2002).

Action B3: Fisheries Management Planning

Undertake actions within the *Fisheries Management Plan for Fisheries Management Zone 17* on Four Mile Lake.

Priority

- Medium

Rationale

- The Fisheries Management Plan for Fisheries Management Zone 17 was released in 2009 by the Ontario Ministry of Natural Resources and Forestry. The Plan outlines several challenges in maintaining healthy fisheries resources and provides several management strategies that apply to local watercourses, including Four Mile Lake. Strategies within the Plan include: Walleye, Largemouth and Smallmouth Bass, Panfish, Muskellunge and Northern Pike, Coldwater Streams Fisheries, Additional Species (forage fish and species at risk), Invasive Species and Fish Pathogens, Fisheries Awareness and Education, and Monitoring and Assessment. A Fisheries Advisory Council comprised of several key stakeholders including angling clubs, First Nations, tourist associations, academia, and stewardship groups, played a large role in developing the Plan by identifying goals, objectives, and management actions. Implementation of several action items in the Plan would benefit the fishery within Four Mile Lake.

Priority areas

- Fishes that are important to the recreational fishery (walleye, smallmouth bass, largemouth bass, and muskellunge).

Lead and (partner) implementers

- Ontario Ministry of Natural Resources and Forestry; (Fisheries and Oceans Canada; local anglers; lake residents)

Initiatives

- Implement the *Fisheries Management Plan for Fisheries Management Zone 17* on Four Mile Lake, specifically the actions listed below:
 - Identification of critical spawning locations for Walleye, Muskellunge, and Smallmouth Bass.
 - Monitor the fisheries and aquatic ecosystems as they continue to change in response to environment variables.
 - Monitor angler harvest and effort through creel surveys or other means.
 - Monitor for the presence of aquatic invasive species and pathogens as a component of the Broad-scale monitoring program.
 - Report on the State of the Resource based on results of the Broad-scale Monitoring program and other monitoring initiatives.
 - Develop plain-language information materials associated with management actions that can be taken and their potential effectiveness.
- Monitor and report illegal angler practices or harvesting.

Action B4: Protecting large tracts of natural lands

Protect large tracts of land that are ecologically and/or culturally significant.

Priority

- Medium

Rationale

- The long-term protection of ecologically and culturally important areas on the landscape contributes greatly to maintaining a healthy lake ecosystem. The Four Mile Lake watershed already contains large amount of protected areas, including: Altberg Wildlife Reserve, Somerville Tract, and Victoria County Forest. Several tools are available to assist in protecting private and public lands from development including strategic planning, conservation easements, fundraising campaigns, and other mechanisms through which lands can be secured in perpetuity to benefit not only the lake ecosystem but to also provide several benefits to the lake, its ecosystem, and surrounding communities.

Priority areas

- Areas of ecological and/or cultural significance
- Expansion of Altberg Wild Reserve

Lead and (partner) implementers

- Ontario Nature; Kawartha Land Trust (City of Kawartha Lakes; Ontario Ministry of Natural Resources and Forestry; Four Mile Lake Association; watershed residents).

Initiatives

- Develop a strategic plan for the acquisition of additional properties that contain important and/or sensitive ecological (e.g., rare ecosystems) and/or cultural features (e.g., archaeological sites).
 - Utilize the Kawarthas Naturally Connected Natural Heritage Systems Strategy as a tool to guide property acquisition prioritization.
- Investigate the potential for expanding the protected areas of the Altberg Wildlife Reserve.
- Develop stewardship plans for protected lands to ensure that human uses are compatible in terms of protecting the important features and functions of the lands.
- Utilize conservation easements (e.g., Conservation Lands Tax Incentive Program, Managed Forest Tax Incentive Program, etc.) and similar tools (e.g., Environmental Protection Land Use Zoning) to protect sensitive areas on private lands.

3.4 Urban and Rural Infrastructure Strategy

A significant focus of this strategy is the ongoing management of public lake-access areas and minimizing the potential impacts associated with construction projects, including road maintenance. These are primarily municipal responsibilities, with emphasis on enhanced control of stormwater, water quality and quantity, soil erosion, and maintenance of public spaces. Shoreline residents involved in construction projects (e.g., undertaking home and property upgrades) are similarly responsible for ensuring that their activities are not detrimental to the health of the lake.



*Erosion of exposed soils along the outlet of Merrett Creek, from a culvert installation
(Woodworth Drive, July 2016)*

Action C1: Management of public lake-access area

Maintain a safe and accessible public lake-access location through managing access to the boat launch and improving water quality at the beach.

Priority

- Medium

Rationale

- Public access to Four Mile Lake provides a primary connection to the lake. Since there is limited public ownership along the lake shoreline, the public beach and the public boat launch are located on the same property at the end of Hillside Drive. There is a water quality issue at the public beach, as it is posted as unsafe for swimming at least once per year, on average, due to high *E.coli* levels. The specific cause of occasional high *E.coli* levels are not well understood, but likely include a combination of factors including bird feces, pet feces, stormwater runoff over developed areas and roadways, and warm, shallow waters. For over 20 years this space has been managed through a municipal bylaw to safely accommodate both uses and address several other community concerns such as: environmental impacts, resident property thefts, uncontrolled boat traffic, fish population depletion, garbage and waste issues. The bylaw sets timing restrictions for accessing the boat launch by means of a gate that is managed by the Four Mile Lake Association. The existing bylaw provides a good balance in use for this public space. Active management of this public space will therefore increase swimmer safety, enjoyment, and environmental health of the lake.

Priority areas:

- Public beach and boat launch site.

Lead and (partner) implementers

- City of Kawartha Lakes; Four Mile Lake Association; (Haliburton, Kawartha, Pine Ridge District Health Unit)

Initiatives

- Within a five-year period, achieve a target of 100% (no postings in any given year) reduction in the amount of time that public beaches are posted as unsafe for swimming.
 - Conduct routine maintenance such as regular garbage pick-up, clean-up of pet and bird feces, and provision of adequate feces disposal facilities.
 - Investigate the potential to implement higher levels of urban storm runoff management; particularly waters that drain down Hillside Drive.
 - Implement ways to deter birds in the beach vicinity, such as creating and maintaining tall vegetation or wider buffers.
- Fully endorse the current public access point and City of Kawartha Lakes bylaw 97-012: Control of access to the Public Beach and Boat Launch on Four Mile Lake.

Action C2: Responsible construction practices

Ensure that construction projects, particularly road maintenance works, are conducted in a manner that does not degrade water quality or sensitive habitats.

Priority

- High

Rationale

- Routine maintenance of drainage ditches along road networks is often needed to remove the build-up of silt and sediments and to upgrade aging culverts. In the case of roadside ditches, the accumulation of sediments over time may impede the ability of the ditch to drain water efficiently during precipitation events and high-water periods. This is similar to agricultural drainage corridors, where it is also necessary to maintain unimpeded water conveyance during crop growth periods. These practices can potentially involve dredging or altering the channel for increased through-flow. This can damage the aquatic ecosystem, including the harmful alteration of in-stream habitat, destabilization of banks, introduction of excessive sediments into our lake, etc. A number of cost-effective options incorporate the natural environment (e.g., vegetation and its root systems), which will help minimize maintenance costs while protecting the environment. In the case of roadside ditches and construction sites, the focus should be on reducing sediment loading into nearby (downslope) watercourses.

Priority areas:

- Roads with steep slopes and highly erodible soils,
- Roads that drain immediately into lake-connecting watercourses, and
- All construction worksites.

Lead and (partner) implementers

- City of Kawartha Lakes; watershed residents; (construction industry; road associations and private road owners)

Initiatives

- Avoid conducting construction projects within a minimum of 3 metres of shoreline, during sensitive periods for fish and wildlife, or as appropriate.
- Identify and install effective measures to prevent disturbed soils and sediments from migrating into the watercourses. Use standards outlined in the document, *Erosion and Sediment Control Guideline for Urban Construction* (Toronto and Region Conservation Authority, 2006). For example:
 - Focus on site-level containment of sediments, recognizing that advanced controls are often required to protect sensitive natural heritage features.
 - Plant disturbed areas with soil-stabilizing vegetation, preferably native species.
 - Use sediment blankets or matting for disturbed banks.
 - Work in low-flow periods; develop a back-up plan in case of heavy rains/melt.
- Host periodic workshops for contractors, consultants, project managers, and developers to ensure effective communications and knowledge of the most up-to-date measures for controlling the movement of sediments off-site.
- Manage beaver grates on large culverts (e.g., Woodworth Drive at Merrett Creek and Corben Creek North) to ensure that migratory fishes have unimpeded access up and down large tributaries to spawning habitat in spring and early summer.

3.5 Research and Monitoring Strategy

All management decisions, as well as remedial and restorative actions, depend on sound scientific data and knowledge. Further lake-based research will shed light on the many information gaps identified by this planning process, including emerging 21st-century pressures. Further monitoring is crucial for determining the effectiveness of current lake-based programming and for identifying new opportunities to engage stakeholders. This adaptive management approach ensures that priorities remain relevant as new information becomes available.

A key component of this strategy is collaboration among groups and institutions already active on the lake. There is great value in using the expertise of local community members, volunteers, and citizen scientists. We promote the sharing of local knowledge and expertise that, in some cases, spans generations. This will help build plan interest and lead to the increased “buy-in” of local people. As project partners create the momentum, the community is more likely to come on board.



*Kawartha Conservation staff conducting a shoreline survey along the east shore
(Four Mile Lake, August 2016)*

Action D1: Coordinated lake monitoring

Implement a coordinated lake monitoring program that regularly tracks key indicators of lake watershed health, including nutrients, aquatic vegetation, forest cover, fish communities, and oxygen levels.

Priority

- Medium

Rationale

- Routine collection of lake and watershed data provides critical information about the ongoing state of Four Mile Lake and its subwatersheds. It also helps to monitor progress on achieving the planning objectives, while allowing early detection of water quality or aquatic health improvements and/or deterioration. Various agencies and groups are actively monitoring Four Mile Lake and coordination is key to reducing duplication and increasing efficiency. We need to support and take advantage of local monitoring, drawing on contributions from volunteers, community organizations, and local academia.

Priority areas

- The open waters and shoreline of Four Mile Lake

Lead and (partner) implementers

- Four Mile Lake Association; Four Mile Lake residents; Ontario Ministry of Natural Resources and Forestry (Federation of Ontario Cottagers' Associations; Kawartha Lake Stewards Association; colleges and universities; Kawartha Field Naturalists; Ontario Ministry of Environment and Climate Change; Kawartha Conservation)

Initiatives

- Coordinate monitoring activities between academia, agencies, and the local communities.
- Develop a list of science-based lake and watershed health indicators that are practical enough to be understood by the general public. Example indicators include the following:
 - Water quality: nutrient status, temperature, oxygen, etc.;
 - Aquatic ecosystems: Fish communities; aquatic plants, wetlands, etc.; and
 - Terrestrial natural heritage: forest cover, shoreline natural areas, etc.
- Conduct routine monitoring of Four Mile Lake and its subwatersheds using appropriate lake and watershed health indicators.
 - Use a "pressure-state-response" feedback loop for monitoring, so that efforts are directed at (a) recognizing relevant pressures/threats to lake health, (b) determining to what degree these impact the state of lake health, and (c) determining the effectiveness of management response.
 - Increase participation in volunteer-based monitoring programs organized by citizen scientists and local stakeholders, for example:
 - Water quality monitoring as per Lake Partner Program (program administered by the Ontario Ministry of Environment and Climate Change).
 - Invasive species monitoring as per Invading Species Awareness Programs (program administered by Ontario Federation of Anglers and Hunters).
 - Integrate monitoring efforts into secondary and post-secondary institutions, where practical.
- Undertake research and monitoring of Species at Risk (i.e., those species listed by Ontario or Canada as Special Concern, Threatened, or Endangered), including tracking populations and identifying areas of critical habitat.
- Undertake water quality sampling in and around the location of the "Old Dugout" (northwest section of the lake), to determine if there are any legacy contaminants from the historical use of this area as a marina and gas station.

Action D2: Aquatic plant monitoring

Conduct research on aquatic plant distribution, composition, and their ecological and cultural significance to better inform lake management approaches.

Priority

- Medium

Rationale

- Aquatic plants are valued components of the lake ecosystem and can have significant ecological value (e.g., habitat for fish and wildlife), socioeconomic value (e.g., reducing waterfront erosion), and cultural value (e.g., traditional First Nations food). Due to the relatively narrow, shallow nearshore areas of Four Mile Lake, aquatic plants do not occupy a significant portion of the lake. However, personal observations from local shoreline residents suggests that aquatic vegetation is becoming more abundant in recent years and there are some local concerns with respect to aquatic plants impeding lake enjoyment. Proliferation of aquatic plants is often caused by numerous factors, including: introduction of invasive species, clearing of water column in shallow areas, warm water temperatures, limited ice cover, and nutrient enrichment, among others. No comprehensive aquatic plant studies have been conducted on Four Mile Lake. Research is therefore needed to better understand if in fact aquatic plants are proliferating and if so, what the probable causes are.

Priority areas

- Shallow nearshore areas adjacent to populated shorelines

Lead and (partner) implementers

- Four Mile Lake Association; Four Mile Lake residents; (colleges and universities; Kawartha Field Naturalists; Ontario Ministry of Natural Resources and Forestry, Kawartha Conservation).

Initiatives

- Conduct research on aquatic plants in Four Mile Lake, including:
 - How aquatic plants and wetlands have changed over time, and changes that can be expected in the future.
 - Their distribution, composition, and ecological importance in the lake ecosystem.
 - Their cultural significance to local First Nations communities.
 - How various methods of aquatic plant control and management could impact the lake ecosystem (e.g., extensive removal of aquatic plants may contribute to undesirable changes in the aquatic community, such as an increase in algal blooms including cyanobacteria (blue-green algae) blooms, or increased turbidity).

Action D3: Nearshore nutrient monitoring

Conduct research to more accurately identify shoreline sources of nutrients and potential impacts to nearshore areas of the lake.

Priority

- Medium

Rationale

- The purpose of this action is to determine how shoreline dwellings affect nearshore ecosystems in the lake by the release of nutrients. This requires the investigation of nutrient chemistry and ecological processes of the nearshore ecosystems of Four Mile Lake. Such studies will provide better insight into actual contributions from shoreline septic systems, and shoreline development activities, since loading amounts have only been estimated at this time. The main objective of such research is to study the presence and quantity of nutrients in nearshore areas adjacent to shorelines (that vary in the amount and type of residential development), with a particular emphasis on better quantifying septic system impacts. Excessive contributions of nutrients from nearshore areas, specifically malfunctioning septic systems, have the potential to deteriorate water quality.

Priority areas

- Shoreline and nearshore areas.

Lead and (partner) implementers

- Four Mile Lake Association; Four Mile Lake residents; (Kawartha Conservation; Ontario Ministry of Environment and Climate Change; Kawartha Lake Stewards Association)

Initiatives

- Conduct nearshore zone sampling for source detection of nutrients.
- Quantify shoreline nutrient input from septic systems and other sources.
- Stimulate and support additional studies of advanced research that will produce more precise knowledge of septic system nutrient input.

Action D4: Understanding lake ecosystem stressors

Conduct research to identify how the lake ecosystem responds to stressors such as cumulative development, climate change, and invasive species.

Priority

- Medium

Rationale

- The key driver for the proposed research is the already at capacity, and anticipated increase of intensification, of development along the shorelines of Four Mile Lake and the consequent pressures on the lake ecosystem. There is an urgent need to improve scientific understanding about the influence of shoreline development on lake health - particularly within the context of other stressors such as climate change and invasive species - so that appropriate management responses may be developed.

Priority areas:

- Cumulative development along shorelines,
- Climate change, and
- Invasive species in aquatic ecosystems.

Lead and (partner) implementers

- Ontario Ministry of Natural Resources and Forestry; Ontario Ministry of Environment and Climate Change; (Colleges and universities; Kawartha Lake Stewards Association; City of Kawartha Lakes; Kawartha Conservation; First Nations; watershed residents)

Initiatives

- Conduct research on potential lake ecosystem changes resulting from climate change, invasive species, and cumulative shoreline development.
 - Investigate options for predictive modeling tools and decision-support systems to guide management efforts to mitigate any negative impacts of emerging pressures.
- Conduct a climate change vulnerability assessment.
- Conduct research to identify lake and watershed health thresholds and carrying capacity.
 - An example is the Lakeshore Capacity Handbook (Province of Ontario, 2010), a modelling tool applicable to Ontario lakes on the Canadian Shield that predicts lake water quality based on the amount of shoreline development. This tool was tested on Four Mile Lake, but unfortunately it was not successful in predicting existing water quality conditions based on existing shoreline development.
- Utilize traditional ecological knowledge from local First Nations communities.
- Identify various, minimally impacted “reference lakes” the data from which can be used to better understand the range of natural variability expected in healthy aquatic ecosystems.

3.6 Communications and Outreach Strategy

Communication and outreach help set the *Four Mile Lake Management Plan* in motion and provide the mechanisms for Plan updates and adjustments to meet changing community needs and environmental conditions. This involves communicating information about the lake and its subwatersheds; providing actions to sustain a healthy environment, community, and economy; receiving feedback from stakeholders about implementation of the Plan (including Plan updates and adjustments); and assisting collaboration on the Plan and related projects.

The Communication and Outreach Strategy supports the other strategies through these four objectives:

1. Enable informed decision making and actions that contribute to the goal of the Plan.
2. Motivate actions that protect Four Mile Lake.
3. Create the cultural conditions for long-term sustainability of the lake.
4. Provide transparency and accountability for the Plan and its implementation.

Many people have a stake in the implementation of the *Four Mile Lake Management Plan*. They are grouped into target audiences by the different forms of communication and outreach required for implementing the Plan. Audience groups include shoreline property owners, First Nations communities, agricultural and rural landowners, urban residents, businesses, tourists and other visitors, municipal councillors and staff, lake associations, agencies and related organizations, developers, funders, and Kawartha Conservation staff and Board of Directors.

Barriers to implementation (which will be assessed by research in this strategy) include:

- Lack of knowledge of how to properly undertake actions;
- Poor understanding of watershed connections (e.g., the impact of urban residents on the lake), including why specific actions are needed, and the corresponding benefits of those actions;
- Upfront costs and lack of agreement on who is responsible for watershed protection (e.g., landowners may see agencies as responsible, and agencies may see greater need for landowners to take responsibility);
- Good conditions may entrench a “business as usual” attitude;
- Challenges of keeping the brand and awareness of the plan at the forefront; and
- Competing interest for lake users and interpretation of “healthy lake” conditions.

Opportunities to support the implementation of this strategy include:

- Strong involvement from community leaders and representatives of the committees for lake management planning;
- Research and stewardship activities by groups in the watershed such as the Four Mile Lake Association, Kawartha Lake Stewards Association, Fleming College, Federation of Ontario Cottagers’ Associations, and Trent University;
- Outreach such as the Blue Canoe Program, which provides information about lake management planning and collects information through surveys;
- Increasing attention towards aquatic plant growth, blue-green algae, and other symptoms of lake enrichment, as well as invasive species, climate change, and other issues identified in surveys;
- Science to back up the strategies;
- Emphasis in the community on the need for stewardship actions by individual property owners;
- Release of booklets and other communication materials;
- Establishment of a web page for the program and other communication mediums;
- In-house skills, such as online media, writing, and presentation;
- Media coverage surrounding lake management planning, open house events, and other Kawartha Conservation and partner activities.



*Science and Technical Committee meeting
(Lindsay, 2014)*

Action E1: Aquatic plant information and management

Make available to shoreline residents information that profiles the beneficial role of aquatic plants in a lake ecosystem, and provides options to manage nuisance aquatic plants.

Priority

- High

Rationale

- Aquatic plants are beneficial to the Four Mile Lake ecosystem as they provide cover and food for fishes and wildlife, stabilize sediments, uptake nutrients, among other important functions. Notwithstanding, numerous shoreline residents have expressed their observations that aquatic plants are more prolific now than in years past, and have reduced their personal enjoyment of the lake particularly for swimming. Residents would like something done about this issue and are seeking practical and affordable options for aquatic plant management along their waterfront.
- The locations and amounts of aquatic plants growing in Four Mile Lake are largely driven by the natural characteristics of the lake. For example more plants naturally exist in shallow nearshore areas and soft substrates, while fewer exist in deeper offshore areas and hard substrates. There are several other, more manageable factors that contribute to accelerated aquatic plant growth including invasive species and sediment and nutrient enrichment.
- Several communication tools need to be made available and directed to shoreline residents to help them better understand the benefits provided by aquatic plants as well as to better understand the various control/remove options that are available.

Priority areas

- Shoreline residents

Lead and (partner) implementers

- Four Mile Lake Association; Ontario Ministry of Natural Resources and Forestry; Kawartha Lake Stewards Association (Four Mile Lake residents; Kawartha Conservation; City of Kawartha Lakes)

Initiatives

- Update Four Mile Lake Association's, and other lake clubs' websites to provide information on aquatic plants, including:
 - Their importance towards maintaining a healthy Four Mile Lake ecosystem.
 - Options for effective aquatic plant control, within the regulatory context (e.g., permitting) of provincial, federal, and municipal policies.
- Distribute copies and profile online the Aquatic Plants Guide (Kawartha Lake Stewards Association, 2009). Make information accessible through websites and other community forums.
- Actively involve the community in studying aquatic plants (as per Research and Monitoring Strategy: Action D2). Develop and distribute a publication that summarizes research findings and describes aquatic plant ecology in Four Mile Lake.

Action E2: Partner collaboration

Work collaboratively with people and projects that contribute to the objectives of the Lake Plan.

Priority

- High

Rationale

- A large amount of information and analysis has been generated in the development of the *Four Mile Lake Management Plan* that may contribute to other related initiatives in the watersheds. Representatives of a wide range of stakeholders must collaborate on program aspects of the *Four Mile Lake Management Plan*, including science and research, funding proposals, and other project support. They also need to look for unique partnership opportunities for lake management projects.

Priority areas

- Watershed residents, and groups active around/on the lake

Lead and (partner) implementers

- (Watershed Residents; Four Mile Lake Association; Kawartha Conservation; Kawartha Lake Stewards Association; City of Kawartha Lakes; Ontario Nature; Kawartha Field Naturalists; First Nations; provincial ministries; Federation of Ontario Cottagers' Associations; community organizations)

Initiatives

- Provide research and information from the Plan and support objectives relevant to the Plan. With this goal, participate in working groups and committees, and work with organizations such as the following:
 - Cottage, lake, and rate payer associations and environmental groups;
 - Government agencies;
 - Conservation authorities;
 - Educational institutions such as Fleming College, Trent University, the Trillium Lakelands District School Board, and the Peterborough Victoria Northumberland and Clarington Catholic District School Board;
 - Williams Treaty First Nations;
- Provide assistance with the incorporation of plan research and analysis, and the implementation of best management practices to organizations. Main target audience: municipal councillors and staff, watershed residents; lake associations, agencies and related organizations, developers and contractors.

Action E3: Keeping stakeholders informed

Communicate the science, solutions, and outcomes of plan implementation.

Priority

- High

Rationale

- A large amount of information and analysis has been generated through Plan development, providing a baseline for setting environmental targets. It enables informed decision-making and actions that contribute to the goal of the Plan. Through information sharing it will be possible to track any improvement or decline in conditions, measure the effectiveness of actions, and respond to emerging issues in a changing environment. Transparency and accountability to stakeholders are necessary for ongoing funding and support for Plan implementation.

Priority areas

- Watershed residents, and groups active around/on the lake

Lead and (partner) implementers

- Four Mile Lake residents; Four Mile Lake Association; (watershed residents; Kawartha Conservation; Kawartha Lake Stewards Association; City of Kawartha Lakes; Ontario Nature; Kawartha Field Naturalists; First Nations; provincial ministries; developers and contractors; Federation of Ontario Cottagers' Associations; community organizations)

Initiatives

- Make available all relevant report and studies that are related to Four Mile Lake to local residents; consider digitally compiling reports and posting online within a central location (e.g., Four Mile Lake Association, Kawartha Conservation, website, etc.).
- Distribute reports on monitoring results, implementation of stewardship actions, impacts of actions, and other changes in the watershed.
- Provide updates via newsletters, social media, local media, and budgets.
- Maintain a web page for lake management planning to host reports, updates, and related resources.
- Develop infographics and posters that include facts and findings about Four Mile Lake, issues and solutions, ecological connections, and human-environment relationships. The graphics should be professionally designed and suitable for hanging in cottages, offices, and other settings; for posting online; and for distributing through social media.
- Provide presentations by request, to distribute the latest information and updates, answer questions, and talk directly with people, agencies, organizations, and interest groups in the community.
- Use annual meetings of local organizations (e.g., Four Mile Lake Association and Kawartha Lake Stewards Association Annual General Meetings) to review lake monitoring programs and discuss regional projects of interest to their membership.
- Use the Blue Canoe program to distribute information to shoreline property owners and lake associations.

Action E4: Community Advisory Panel

Maintain the Community Advisory Panel to ensure effective communication, agency support, and collaboration among lake stakeholders during Plan implementation.

Priority

- Medium

Rationale

- With the implementation of the *Four Mile Lake Management Plan*, maintaining relationships among all project partners is essential for communicating with the broader watershed community. The existing Community Advisory Panel is a logical forum to continue to help provide this function. One particular benefit of Four Mile Lake residents being involved in the Community Advisory Panel (a group consisting of multiple stakeholders representing several lakes within the Kawartha Lakes region) is the ability to share information and learn from personal experiences in lake management approaches.

Priority areas

- Kawartha Lakes wide

Lead and (partner) implementers

- Kawartha Conservation; City of Kawartha Lakes (watershed residents; shoreline residents)

Initiatives

- Maintain representation from Four Mile Lake on the Community Advisory Panel membership.
- Focus on promoting, undertaking, and evaluating Plan implementation.
 - Maintain the partnerships from the lake study and research period.
 - Receive input on Plan implementation, and on changes in the landscape and in communities.
 - Assist with funding proposals and acquisition of resources for program delivery.
 - Take ownership of monitoring the completion of implementation actions.

Action E5: Science and Technical Committee

Maintain the Science and Technical Committee to ensure effective communication, support, and collaboration among monitoring and research-based organizations.

Priority

- Medium

Rationale

- A Science and Technical Committee provided specialized input and leadership pertaining to the science and research processes during the development of the Four Mile Lake Planning project. The membership of the committee covers many areas of expertise and knowledge (e.g., water quality, aquatic biology, etc.), and it includes organizations with an interest in the outcomes of the lake management planning, and in the scientific research of the lake ecosystem. Since research and monitoring are integral components of the lake management process, this group should continue to provide input and support through the implementation of the *Four Mile Lake Management Plan*.

Priority areas

- Kawartha Lakes wide

Lead and (partner) implementers

- Kawartha Conservation; colleges and universities; (watershed residents; shoreline residents)

Initiatives

- Maintain Four Mile Lake as an area of focus within the Science and Technical Committee, with an increasing emphasis on supporting Plan implementation efforts.
 - Maintain and build on partnerships developed during the lake study and research period.
 - Receive input on Plan implementation and emerging issues.
 - Assist with funding proposals and acquisition of resources for science and research delivery.
- Communicate on a regular basis to ensure technical information sharing.

Action E6: Stakeholder input

Create opportunities for stakeholder input through plan implementation, and assess stakeholder concerns, barriers, and knowledge gaps regularly.

Priority

- Medium

Rationale

- This action helps evaluate the implementation of the *Four Mile Lake Management Plan* and encourages an open forum for updates to the Plan. This is important as the landscape changes demographically, climatically, ecologically, culturally, and in other ways. An understanding of community needs, values, concerns, interests, culture barriers, and knowledge gaps is critical to effective communication and program implementation.

Priority areas

- Shoreline residents

Lead and (partner) implementers

- Watershed residents; City of Kawartha Lakes; Four Mile Lake Association; (Kawartha Conservation)

Initiatives

- Conduct a representative knowledge, attitudes, and behaviours (KAB) survey of the watershed population to create a baseline. Conduct future surveys to measure changes.
- Obtain public and stakeholder feedback on reports to gauge perceptions of the state of the lake and direction of the Plan, through a survey.
- Compile and analyse other surveys and audience research undertaken in the priority area.
- Implement customer relations tracking/demographics mapping software to manage information collected about each target group through stewardship activities, surveys, and other sources.

Action E7: Profile Four Mile Lake

Profile the natural heritage features, social values, and economic values associated with Four Mile Lake, including a long-term vision for the lake and a shared sense of responsibility to protect it.

Priority

- Medium

Rationale

- Many significant natural and cultural features make up Four Mile Lake and the surrounding lands. Encouraging an ecological perspective involves recognizing connections between people and their actions on the landscape. This perspective highlights how ecological ties are also community and economic ties; what one does on the land has ecological implications for the local community and economy. This provides a foundation for stewardship activities and promotes Four Mile Lake as a desirable place to visit and invest.

Priority areas

- Significant features within the watershed

Lead and (partner) implementers

- City of Kawartha Lakes; Four Mile Lake Association; (watershed residents; Kawartha Conservation; Federation of Ontario Cottagers' Associations; First Nations; Ontario Nature)

Initiatives

- Contribute information about the lake and its natural features to tourism-focused and other communication sources that profile the City of Kawartha Lakes and Four Mile Lake. Main target audience: tourists and other visitors, funders, businesses, shoreline property owners, and recreational groups.
- Contribute information about the lake, its natural features, and protection ideas to local school curricula, and other local environmental education programming.
- Build a strong brand for the Plan that signifies shared responsibility, community effort, science-based programming, cultural significance, and ecological, community, and economic ties.
- Profile the connections between protected lands (e.g., Altberg Wildlife Reserve, Somerville Tract, etc.) and maintaining healthy lakes.
- Raise awareness of Species at Risk (i.e., species listed by Ontario or Canada as Special Concern, Threatened, or Endangered), including profiling species known to occur in the area, their habitat requirements, and their associated legislative protections.

Action E8: Community outreach

Undertake Community Outreach to motivate shoreline residents to implement lake and watershed friendly lifestyles, and to make connections in the community.

Priority

- Medium

Rationale

- Community Outreach is an important addition to our communications tools and strategies as it allows for direct in-person contact, effectively targets specific demographics, and also plays an educational role. This outreach will also enable shoreline residents to understand that their property specifically can have a positive impact on the health of the lake.

Priority areas

- Shoreline residents

Lead and (partner) implementers

- Watershed residents; Kawartha Conservation; Ontario Ministry of Natural Resources and Forestry (Four Mile Lake Association; Federation of Ontario Cottagers' Associations)

Initiatives

- Maintain the Blue Canoe program, a communication initiative that provides waterfront property owners with information about the responsible management of shorelines; deliver Blue Canoe to shoreline residents on Four Mile Lake.
- Place signs or stickers that serve as a reminder near a voluntary action location.
- Publish stories featuring people who take action: online (website, interactive map), in social media and video, in stewardship presentations, and through traditional media.
- Attend public events such as lake association meetings to promote best management practices in lake stewardship and talk about the conditions impacting the lake and Plan milestones reached.

3.7 Moving To Implementation

The *Four Mile Lake Management Plan* provides a solid framework for a coordinated approach to maintaining a healthy lake and subwatersheds for all uses. However, successful implementation will require ongoing commitments (financial and otherwise) from all identified partners to fully realize and sustain a healthy lake environment. Fortunately the Four Mile Lake Association is a long-standing and well-coordinated group of individuals that have a keen interest in taking an active role in managing their lake resources.

Creating and maintaining effective partnerships is essential to the success of this management plan. The more stakeholders, resources, and knowledge applied to each action item, the better the result. Everyone around the lake is accountable for responsible lake management. Early implementation efforts should highlight small successful projects from individuals and groups to build momentum.

Many of the strategies and actions developed in this plan can be applied to other lakes as well. However, we have focused primarily on the priorities of stakeholders and ecosystem-based issues specific to Four Mile Lake. Careful consideration is needed in applying management approaches from this plan to other lakes, as each lake is unique with its own set of issues and community-based values.

To assess progress and remain accountable, the *Four Mile Lake Management Plan* should be reviewed and updated, if necessary, in a five- to 10-year time period. Reporting and evaluating the progress of project initiatives should be conducted more often, for example, on an annual basis.

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Appendix A: Key Communities and Stakeholders

Everyone has a role to play in maintaining a healthy Four Mile Lake. A wide range of communities, organizations, and individuals depends on healthy lake conditions to sustain their livelihoods. Successful implementation of the management actions identified in Chapter 3 relies heavily on a cooperative approach among these stakeholders for their support and direction. Table A provides a working list of key lake-based communities, stakeholders, and agencies.

Table A: Key lake management communities, stakeholders, and agencies

First Nations	Williams Treaty First Nations
Federal Government	Fisheries and Oceans Canada; Transport Canada
Provincial Government	Ministry of Natural Resources and Forestry (Bancroft District, Science and Research Branch); Ministry of the Environment and Climate Change (Eastern Region); Ministry of Municipal Affairs and Housing; Ministry of Transportation; Ministry of Agriculture, Food and Rural Affairs
Municipal Government	City of Kawartha Lakes; Haliburton, Kawartha, Pine Ridge District Health Unit; Township of Minden Hills
Stewardship Groups	Kawartha Lake Stewards Association; Soil and Crop Improvement Association (Environmental Farm Plan); Ontario Nature; Kawartha Field Naturalists; Ontario Federation of Anglers and Hunters; Ducks Unlimited; Kawartha Land Trust; Kawartha Conservation; City of Kawartha Lakes Environmental Advisory Committee; Lakeland Alliance; Friends of the Osprey;
Agriculture	City of Kawartha Lakes Agricultural Development Advisory Board; Victoria County Soil and Crop Improvement Association; Victoria-Haliburton Federation of Agriculture; Victoria Cattlemen's Association; and others
Lakeside Communities	Four Mile Lake residents; Four Mile Lake Association; Federation of Ontario Cottagers' Associations
Academia	Trillium Lakelands District School Board; Kawartha Pine Ridge District School Board; Peterborough Victoria Northumberland and Clarington Catholic District School Board; Fleming College; Trent University and other academic institutions
Lake-related Businesses and Clubs	Scouts Canada, Lindsay Bassmasters, Muskies Canada, Boys & Girls Clubs of Kawartha Lakes, and others

Appendix B: Existing Planning Initiatives

A number of current management planning initiatives relate to the *Four Mile Lake Management Plan* goal of maintaining a healthy and sustainable Four Mile Lake. To realize this goal, support for these initiatives is crucial. For maximum leverage, efforts should be integrated wherever possible. The following initiatives are particularly relevant:

- Our Kawartha Lakes Integrated Community Sustainability Plan (City of Kawartha Lakes, Draft, 2013). This plan, led by the local municipality, provides a framework for sustainable management for 10 key themes: Water, Agriculture, Natural Systems, Resource Consumption, Health and Education, Economy, Culture and Heritage, Active Communities, Accessibility, and Financial Filter. The plan recognizes lake management planning as a key step in achieving a sustainable municipality. As such, they should be integrated when seeking funding for implementation efforts.
- Shoreline Environmental Studies in Support of Official Plan Policies for the City of Kawartha Lakes (Gartner Lee and French Planning Services, 2002). This initiative resulted in a thorough list of shoreline-based planning advice and approaches, which were recommended to the City of Kawartha Lakes for integration into their Official Plan. Many of these were considered in the development of the Strategic Planning Strategy outlined in Chapter 3.
- Official Plans for City of Kawartha Lakes. The Official Plan is a policy document containing a statement of Council's commitments to guide development and land use within the municipality. The Official Plan contains a number of policies that address protection of water resources including lakes and water quality. It allows implementation for a number of planning tools including Secondary Plans (more detailed plans of a specific area), Zoning and other by-laws, Subdivision Control, Consent Applications (to sever land into a limited number of parcels), and Site Plan Control. Currently Four Mile Lake is listed as a Special Policy Areas within the Official Plan, with accompanying unique land use policy.
- Kawarthas, Naturally Connected Natural Heritage Systems Strategy (Ontario Ministry of Natural Resources, Draft, 2013). This strategy identifies significant landscape features and functions in the Kawartha Lakes region that help maintain functioning ecosystems. Using a base set of ecosystem-based targets (e.g., maintaining 30% forest cover on the landscape), the strategy will determine which landscape-level features are priority areas for protection and/or restoration. All of the Four Mile Lake planning area is within the scope of this initiative. Accordingly, the completed strategy will be a valuable tool for the implementation of many action items outlined in Chapter 3.
- Four Mile Lake Evaluation of Fish and Wildlife Habitat (Michalski Associates, 1986). This comprehensive evaluation of the ecological state of Four Mile Lake was undertaken at the behest of the Four Mile Lake Association. This report provided multiple recommendations to sustain a healthy Four Mile Lake including: establishing and protecting shoreline buffer strips, rehabilitating lost fish and wildlife habitat, and enhanced septic system and *E.coli* evaluations.
- Fisheries Management Plan for Fisheries Management Zone 17 (Ontario Ministry of Natural Resources, 2009). This plan provides provincial direction for the management of fisheries resources within the Kawartha Lakes management zone, including recreational use as well as science and monitoring aspects. The plan presents management strategies for the following themes: Walleye, Largemouth and Smallmouth Bass, Panfish, Muskellunge and Northern Pike, Coldwater Stream Fisheries, Other Fish Species, Invasive Species and Disease Management, Awareness and Education, and Monitoring and Assessment. Successful implementation of this plan will be crucial for achieving objectives identified in Chapter 2.
- Relevant Provincial and Federal Legislation. Various pieces of legislation provide the foundation for planning, policy, and/or plan implementation. The federal statutes of most relevance include: the *Historic Canals*

Regulations, Fisheries Act, Navigation Protection Act (formerly the Navigable Waters Protection Act), Species at Risk Act, Migratory Birds Convention Act, Canadian Environmental Assessment Act, and Canadian Environmental Protection Act. The provincial statutes of most relevance include: the Planning Act, Clean Water Act, Conservation Authorities Act, Endangered Species Act, Environmental Assessment Act, Fish and Wildlife Conservation Act, Green Energy Act, Lakes and Rivers Improvement Act, Oak Ridges Moraine Conservation Act, Public Lands Act, Ontario Water Resources Act, Nutrient Management Act, Drainage Act, Pesticides Act, and Environmental Protection Act.

Appendix C: Assessment of Action Priority

The following provides more details with respect to the outcomes of evaluating each management action, contained within Chapter 3: Implementation Strategies, against five criteria.

CRITERIA	Level	Value	Details
#1. Action meets multiple objectives?	High	3	Meets many (over half of) objectives
	Medium	2	Meets a few objectives
	Low	1	Meets a single objective
#2. Action is affordable?	High	3	Cost < \$5,000; easy to acquire local funding
	Medium	2	Cost >\$5,000 and <\$50,000; typical medium project proposal
	Low	1	Cost >\$50,000; must acquire significant funding
#3. Action has support from community?	High	3	Overwhelming support
	Medium	2	Majority support
	Low	1	Localized support
#4. Action builds public support for implementation?	High	3	High profile; includes a large number of stakeholders
	Medium	2	Medium profile; includes a medium number of stakeholders
	Low	1	Low profile; includes a small number of stakeholders
#5. Action has timely environmental benefit?	High	3	Short term (5 years or less) improvement
	Medium	2	Long term (5 years or more) improvement
	Low	1	Maintain status quo

ACTIONS	Criteria Number					Summed	Average	Priority
	#1	#2	#3	#4	#5			
STEWARDSHIP STRATEGY								
A1: Undertake responsible management of septic systems, including routine inspections, along shoreline properties.	2	3	3	3	2	13	2.6	High
A2: Undertake measures to reduce the risk of transferring aquatic and terrestrial invasive species into the lake and its watershed.	2	3	3	3	2	13	2.6	High
A3: Manage stormwater runoff by increasing the filtering and absorbing capacity of shoreline properties.	2	3	2	2	1	10	2	Medium
A4: Maintain the natural features along the shoreline.	2	3	2	2	2	11	2.2	Medium
A5: Undertake responsible recreational boating within the lake, including routine equipment inspection and minimizing disturbance to sensitive habitats.	2	3	2	1	1	9	1.8	Medium
STRATEGIC PLANNING STRATEGY								
B1: Maintain Four Mile Lake as a Special Policy Area within the municipal Official Plan, and keep the existing policies that apply to the Waterfront Designation intact.	2	3	3	3	2	13	2.6	High
B2: Consider various regulatory options for preventing the clear-cutting of large forested areas along the shoreline.	2	3	2	2	2	11	2.2	Medium
B3: Undertake actions within the <i>Fisheries Management Plan for Fisheries Management Zone 17</i> on Four Mile Lake.	1	2	2	2	2	9	1.8	Medium
B4: Protect large tracts of land that are ecologically and/or	2	1	2	3	2	10	2	Medium

culturally significant.								
URBAN AND RURAL INFRASTRUCTURE STRATEGY								
C1: Maintain a safe and accessible public lake-access location through managing access to the boat launch and improving water quality at the beach.	2	3	3	2	2	12	2.4	Medium
C2: Ensure that construction projects, particularly road maintenance works, are conducted in a manner that does not degrade water quality or sensitive habitats.	2	3	2	3	3	13	2.6	High
RESEARCH AND MONITORING STRATEGY								
D1: Implement a coordinated lake monitoring program that regularly tracks key indicators of lake watershed health, including nutrients, aquatic vegetation, forest cover, fish communities, and oxygen levels.	1	2	3	3	1	10	2	Medium
D2: Conduct research on aquatic plant distribution, composition, and their ecological and cultural significance to better inform lake management approaches.	1	2	3	3	1	10	2	Medium
D3: Conduct research to more accurately identify shoreline sources of nutrients and potential impacts to nearshore areas of the lake.	1	2	2	2	1	8	1.6	Medium
D4: Conduct research to identify how the lake ecosystem responds to stressors such as cumulative development, climate change, and invasive species.	1	1	3	3	1	9	1.8	Medium
COMMUNICATIONS AND OUTREACH STRATEGY								
E1: Make available to shoreline residents information that clarifies options for aquatic plant control.	2	3	3	3	3	14	2.8	High
E2: Work collaboratively with people and projects that contribute to the objectives of the lake Plan.	3	3	3	3	1	13	2.6	High
E3: Communicate the science, solutions, and outcomes of plan implementation.	3	2	3	3	2	13	2.6	High
E4: Maintain the Community Advisory Panel to ensure effective communication, agency support, and collaboration among lake stakeholders during Plan implementation.	2	2	2	3	1	10	2	Medium
E5: Maintain the Science and Technical Committee to ensure effective communication, support, and collaboration among monitoring and research-based organizations.	1	2	2	2	1	8	1.6	Medium
E6: Create opportunities for stakeholder input through plan implementation, and assess stakeholder concerns, barriers, and knowledge gaps regularly.	2	3	3	3	1	12	2.4	Medium
E7: Profile the natural heritage features, social values, and economic values associated with Four Mile Lake, including a long-term vision for the lake and a shared sense of responsibility to protect it.	3	2	3	3	1	12	2.4	Medium
E8: Undertake Community Outreach to motivate shoreline residents to implement lake and watershed friendly lifestyles, and to make connections in the community.	3	2	2	3	2	12	2.4	Medium