INTRODUCTION

SHIFTING BASELINES AND THE MUSKOKA WATERSHEDS

The 2023 Muskoka Watershed Report Card is the 6th report card issued by the Muskoka Watershed Council (MWC) since 2004. With this near-twenty-year record of reporting, it is appropriate that we focus as much or more on trends in the status of our environment as on its current state.

In each of its previous report cards, MWC has concluded that the overall health of our environment is very good, although some concerning trends have been detected. If MWC were to continue its emphasis on current status in 2023 and into the future, the message would continue to be, overall, a comforting one: the health of our environment is generally very good. We are very lucky to live here and fortunate that wise management of environment has prevailed. The downward trends in environmental health that have been reported are all gradual and unless the circumstances deteriorate suddenly, it will be many years before MWC is forced to report that the health of our environment is poor.

The Muskoka community faces the risk of what ecologists call the *shifting baseline syndrome*. Every few years, attempting to report on the overall health of an ecosystem, observers can find the situation little changed from the last time they looked into it despite the fact that it has been slowly degrading year by year. The observers have mentally re-set their baselines, based on the immediate past, forgetting what things were like decades earlier. From this can come complacency.

This shifting of baselines is a natural human process which makes it very difficult to see slow changes, even when setting out explicitly to measure and report any such changes; we continuously modify our unconscious baseline expectations. The shifting baseline syndrome fools professional scientists charged with measuring and monitoring environmental conditions just as much as it fools the public. It is a major reason why so many fisheries around the world,

such as Canada's Atlantic Cod fishery, have collapsed despite being carefully managed. Deteriorating trends have been seen and recorded, but the long-term impact of them has not been appreciated until far too late. It is also why parks and conservation areas can seem to be 'in good condition' over many years, only to be found to be seriously degraded by overuse or inappropriate use subsequently. In this Report Card, we strive to guard against letting our baselines shift.

THE GOAL

In producing this Report Card, MWC intends to raise public awareness of the state of our environment, and to identify any undesirable trends in environmental health that need to be corrected if the long-term health of this environment is valued. No part of Muskoka is now in pristine condition, unaffected by the presence of humans: the goal of MWC in producing periodic report cards is to remind people of the environment's current state and whether that state appears to be drifting further away from pristine conditions. This information can be used by individuals and by those charged with protecting/conserving our environment to guide changes in behaviour as well as in policies and regulations that should remedy deleterious trends before the state of the environment becomes irretrievably poor.

Using available local data, MWC's Report Card evaluates ecological conditions, general threats, and drivers of change. It identifies areas of special concern and highlights emerging issues such as climate change. At the same time, the Report Card identifies needed new research. It spotlights the important work being undertaken by various local organizations and offers a pathway for those interested in delving deeper into background information sources.

The 2023 Muskoka Watershed Report Card is intended for a wide audience: from individuals and organizations to planners and policy makers. The Report Card draws on existing scientific assessments and uses expert analysis across a range of fields.

The Report Card uses a set of indicators to identify present and potential stressors and to evaluate the health of the terrestrial and aquatic resources in the Muskoka watersheds. As well, it includes several *stories* that illustrate current trends and future risks. The environmental evaluations contained within the Report Card are *made-in-Muskoka* and developed with the help of local scientific and expert advisors and augmented by the work of local citizen scientists and volunteers. The Report Card draws data from various sources. Key contributions are derived from data collected by The District Municipality of Muskoka (DMM), the Dorset Environmental

Science Centre (DESC), the Ontario Lake Partner Program (LPP), and Environment and Climate Change Canada (ECCC).

OBJECTIVE

The mission of MWC is *to empower our community to protect and enhance watershed health*. One-way MWC accomplishes this is through the development of Muskoka Watershed Report Cards, which evaluate the ecological health of the watersheds and, in turn, foster awareness and participation in maintaining and hopefully enhancing Muskoka's environmental health.

RATIONALE

MWC commends those municipalities within our region that have consistently prioritized providing sound management of the environment in their official documents, including the policies and regulations they have enacted. Their clear recognition of the economic and non-economic value of a healthy environment, and their efforts over many years, are a major reason why our environment is in as good condition as it is.

For example, DMM, the six Area Municipalities within it, and Seguin Township and Township of Algonquin Highlands all make protection of the natural environment paramount in their Official Plans. Within the Strategic Priorities of DMM approved in 2016, the first goal is to;

"Continue the stewardship of our natural environment - especially water and natural areas – so that they are protected for the values they provide including support for resilient, diverse ecosystems and a vibrant economy."

MWC recognizes the importance of healthy natural areas for all residents of the watershed and has developed the Muskoka Watershed Report Card to assist decision makers in monitoring the success of policies and gauging progress with regard to overall goals for environmental management.

The Report Card is an important management tool because what gets measured gets managed. It also fosters public awareness of environmental issues, an important aspect of rallying support for efforts designed to address them. People will sympathize with a cause only when they understand the problems being faced and the value of what is at stake. The Report Card evaluates whether the vision of maintaining functioning natural ecosystems is being achieved

and identifies where vulnerabilities exist. It may also focus management actions where needed and track progress over time.

THE MUSKOKA ENVIRONMENT

The Muskoka environment, that wonderful mix of rocks, trees and water, is a living ecological system. It is rich in native plants and animals, possesses great scenic beauty, and sustains the major sectors of an economy built on tourism and outdoor recreation, while also providing important natural resources and sustaining our lives in less material ways. This is an environment whose health is of intrinsic economic and cultural importance to the local community and to Ontario. Most people who live and work in Muskoka understand the close links between our environment and our economy, as well as the many ways in which this vibrant natural environment enriches their own lives. Most people also understand that this environment can only be kept healthy through wise management. This Report Card provides the information needed to enable individuals, community groups, the corporate sector, and government at all levels to plan and to modify their activities in ways that will maintain and even restore the overall health of this environment while enabling our human endeavors to also be sustained.

THE MUSKOKA WATERSHEDS – TIME FOR SOME GEOGRAPHY

So, what are the Muskoka watersheds? A watershed or drainage basin is that area of land on which surface waters drain towards a particular waterway; it is defined by those water flows and the natural variations in elevation that underlie them. Every piece of land lies within a watershed. Watersheds, by their nature, can be nested within still larger watersheds, and geographers speak of nested sets of primary, secondary, tertiary, and quaternary (or even smaller scale) watersheds.

In Canada, the GeoBase Surface Water Program, within Natural Resources Canada, has responsibility for systematizing, naming and numbering, the many watersheds that comprise our landscape. The region we mostly think of as *Muskoka* lies within the Great Lakes-St. Lawrence primary watershed and the Lake Huron secondary watershed. Within that secondary watershed are a number of tertiary watersheds. Tertiary watershed No. 02EB, the Muskoka River Watershed, occupies that region of central Ontario stretching from the headwaters of the North and South branches of the Muskoka River in Algonquin Provincial Park, south and west through Lake Muskoka, continuing as the Moon River and the Musquash River which jointly deliver the water to Georgian Bay. This watershed is the primary focus of this Report Card. Directly south of No. 02EB lies tertiary watershed No. 02EC, the Severn River-Lake Simcoe Watershed.

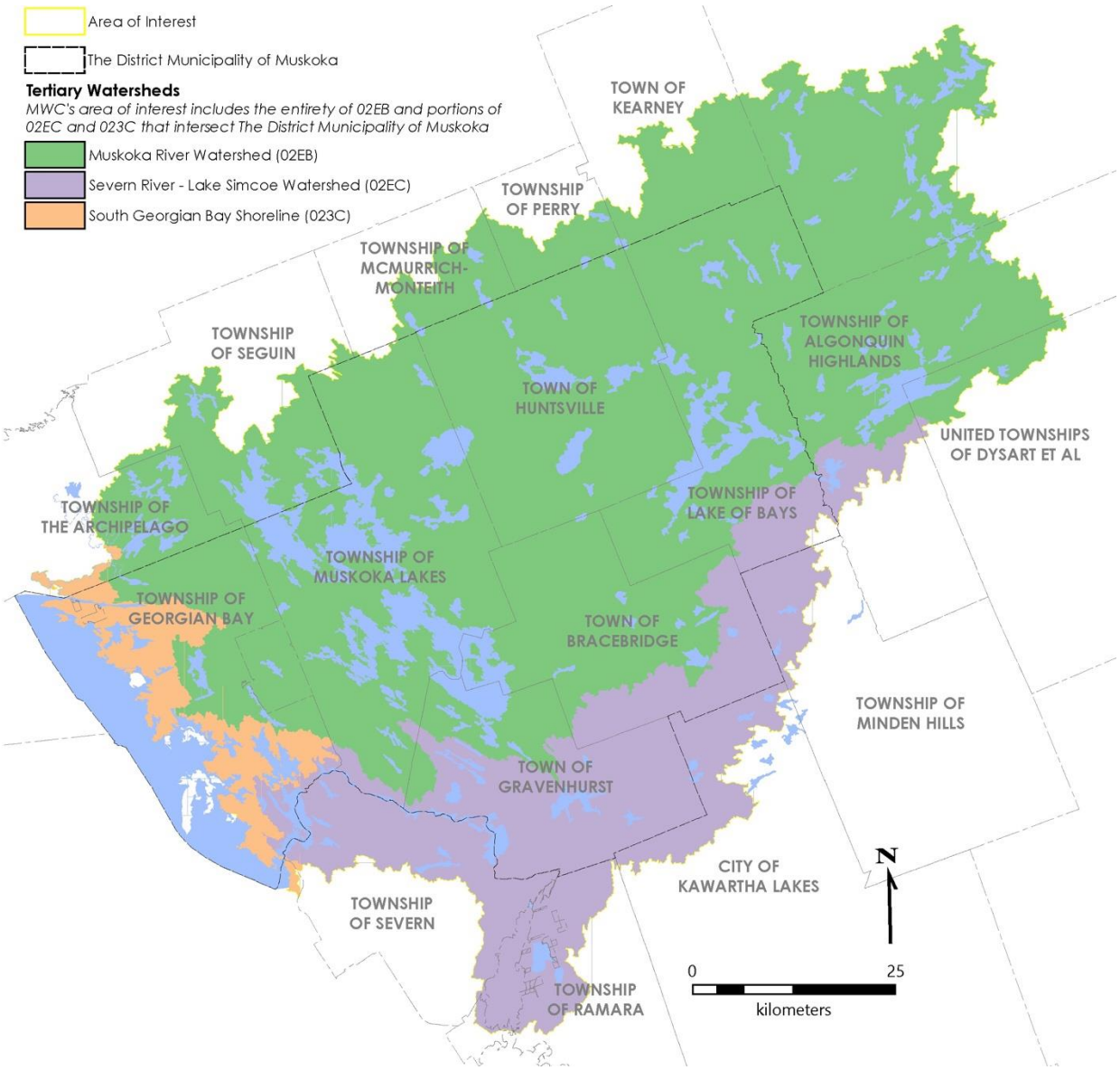

Figure 1. Tertiary watersheds that make up the region referred to in this Report Card as the Muskoka watersheds. The area shaded as a portion of 02EC is the combined area of the five quaternary watersheds within 02EC that lie partially within the District Municipality of Muskoka. Watershed 02EC extends further to the south.

About 70% of the Muskoka River Watershed lies within DMM, but seven other lower-tier and three other upper-tier municipalities include portions of this watershed. Small portions of the Severn River-Lake Simcoe Watershed also fall within DMM.

In addition to watersheds 02EB and 02EC, the western boundary of our area of interest includes three small portions of land draining directly to Georgian Bay. These are part of tertiary watershed No. 023C, South Georgian Bay Shoreline. Still, these small portions of land are also included within DMM. This Report Card covers *all of the Muskoka River Watershed plus those portions of the Severn River-Lake Simcoe Watershed and the South Georgian Bay Shoreline* that lie within DMM.

When this Report Card refers to the *Muskoka watersheds* it is referring to all of No. 02EB (the Muskoka River Watershed), the small portion of No. 023C, South Georgian Bay Shoreline, and those portions of No. 02EC (the Severn River-Lake Simcoe Watershed), that lie within the District of Muskoka. In this, MWC's *area of interest* remains unchanged from previous report cards.

At the level of quaternary watersheds, readers may notice some changes from 2018. Responsibility for designating quaternary watersheds in Ontario lies with the Ministry of Natural Resources and Forestry (MNRF). At the smaller geographic scales of quaternary watersheds, the ability to accurately define boundaries is constrained by the available detailed mapping data, and MNRF undertook to redefine the quaternary watersheds using the most up-to-date, high-resolution lidar data. In doing this revision, MNRF also made some decisions to split large riverine watersheds to create a set of more or less equal-sized pieces of the landscape. The revised watershed boundaries were published in early 2020.

As a result, the quaternary watersheds of 2023 are mostly changed from the quaternary watersheds in place when we produced the 2018 Report Card. Only two names remain unchanged, and identification codes have been reassigned. Rest assured that the land has not shifted, only the bureaucracy that provides us with official names and boundaries. So, in 2023, we say goodbye to the Dee River, Mary Lake, and Gibson River quaternary watersheds (among others), while saying hello to the Musquash River, Lake Vernon, and Blackstone Harbour quaternary watersheds (among still others), and the boundaries of all except possibly the Hollow River and Kahshe River quaternary watersheds have been altered. Once more, nothing has changed on the ground, only our official names for particular places. In 2023, there are 19 quaternary watersheds, plus three small portions of tertiary watershed 023C, South Georgian

Bay Shoreline, falling within the region referred to as the Muskoka watersheds. No. 023C has not been mapped at a quaternary level. These are shown in Figure 2 and listed in Tables 1 and 2.

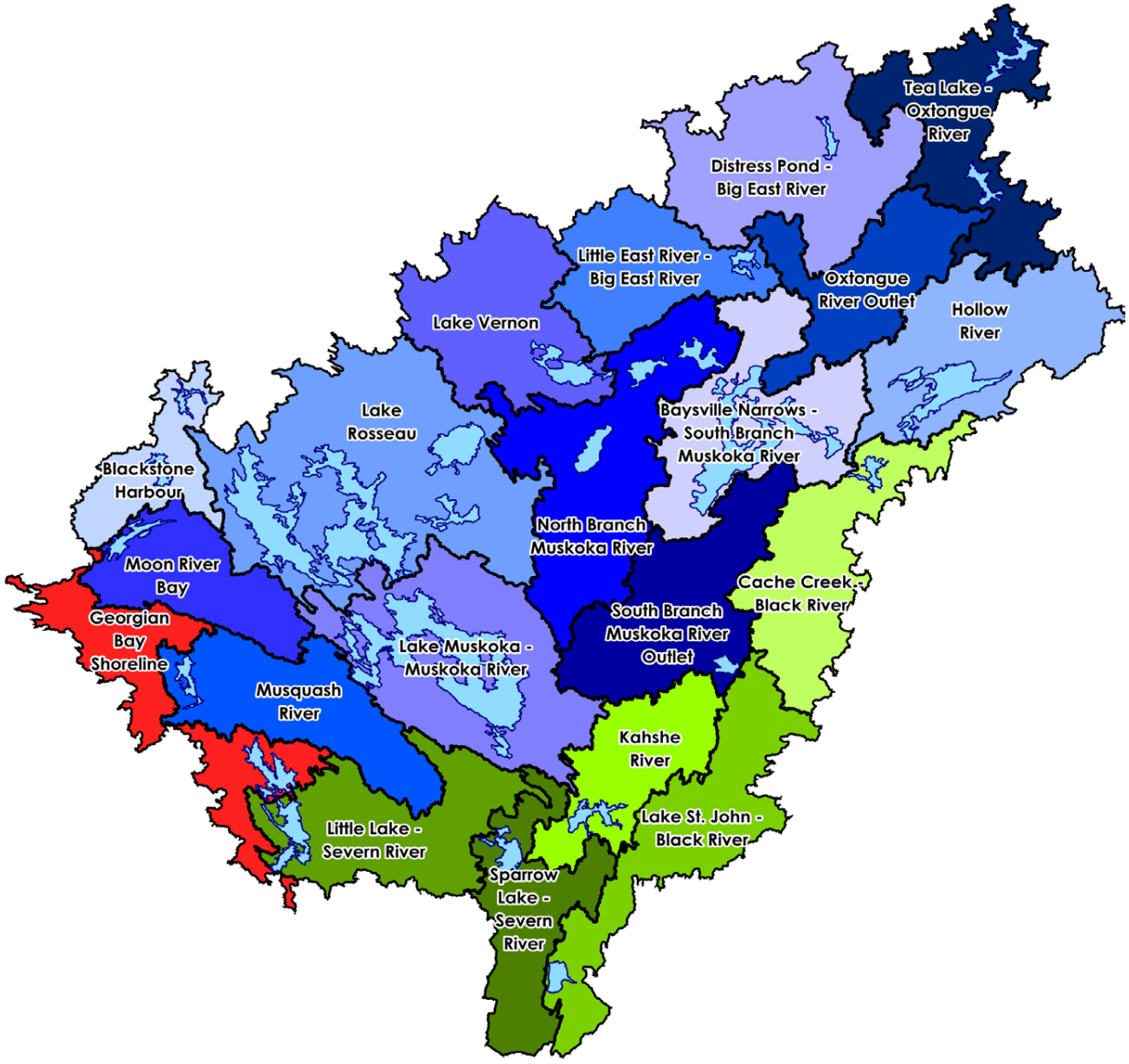

Figure 2. The 19 quaternary watersheds, and the portion of tertiary watershed, South Georgian Bay Shoreline, for which we evaluate data and report on environmental health. Also shown are the major lakes, to enable locating places on this map.

Table 1. Codes, names, and areas* of the quaternary watersheds comprising the Muskoka River Watershed (No. 02EB), and the previous codes and names of watersheds containing each piece of the landscape.

Watershed Code	Watershed Name	Area (Hectares)	Previous Code	Previous Name
02EB-01	Moon River Bay	24,011.19	2EB-02 (part)	Moon River
02EB-02	Blackstone Harbour	17,456.84	2EB-02 (part)	Moon River
02EB-03	Musquash River	31,763.96	2EB-02 (part), 2EB-03	Moon River, Gibson River
02EB-04	Lake Muskoka-Muskoka River	52,488.53	2EB-04, 2EB-14 (part)	Lake Muskoka, North Muskoka River (part)
02EB-05	South Branch Muskoka River Outlet	36,393.19	2EB-09 (part)	South Muskoka River (part)
02EB-06	North Branch Muskoka River	48,281.23	2EB-14 (part)	North Muskoka River (part)
02EB-07	Baysville Narrows-South Branch Muskoka River	39,041.49	2EB-09 (part)	South Muskoka River (part)
02EB-08	Lake Vernon	36,958.74	2EB-13 (part)	Mary Lake (part)
02EB-09	Lake Rosseau	79,570.26	2EB-05, 2EB-06, 2EB-07, 2EB-08	Lake Rosseau, Rosseau River, Skeleton River, Dee River
02EB-10	Little East River-Big East River	27,566.35	2EB-10 (part) 2EB-15 (part) 2EB-16 (part)	Lake of Bays (part) Big East R (part) Little East R (part)
02EB-11	Oxtongue River Outlet	27,023.02	2EB-10 (part) 2EB-11 (part)	Lake of Bays (part) Oxtongue River (part)
02EB-12	Distress Pond-Big East River	46,473.53	2EB-15 (part)	Big East River (part)
02EB-13	Hollow River	40,922.21	2EB-12	Hollow River
02EB-14	Tea Lake-Oxtongue River	34,369.41	2EB-11 (part)	Oxtongue River (part)

** Columns 1-3 (from left) are downloaded from the Ontario Watershed Boundaries list at https://www.arcgis.com/home/item.html?id=0391524acaa64dad9d0eba7efbb6794d#data. Columns 4-5 are based on a comparison with earlier data.*

Table 2. Codes, names, and areas** of quaternary watersheds that together comprise the Severn River-Lake Simcoe Watershed (No. 02EC), and the previous watersheds containing each piece of the landscape. Shaded rows (pale blue) are watersheds that fall outside the MWC area of interest. The final row (pale green) represents three portions of tertiary watershed 023C, South Georgian Bay Shoreline, that drain directly to Georgian Bay. Quaternary watersheds have not been defined for 023C.

Watershed Code	Watershed Name	Area (Hectares)	Previous Code	Previous Name
02EC-01	Little Lake-Severn River	34,516.75	2EC-17 (part)	Severn R (part)
02EC-02	Sparrow Lake-Severn River	26,771.22	2EC-17 (part)	Severn R (part)
02EC-03	Lake Simcoe	8,873.53		
02EC-04	Lake St John-Black River	37,643.36	2EC-14 (part)	Lower Black River (part)
02EC-05	Head River	61,974.57		
02EC-06	Holland River	35,812.75		
02EC-07	Pefferlaw River	42,837.44		
02EC-08	Talbot River-Trent Severn Waterway	35,884.80		
02EC-09	Cache Creek-Black River	33,523.66	2EC-15	Upper Black R
02EC-10	Black River	32,706.81	2EC-14 (part) 2EC-17 (part)	Lower Black R (part) Severn River (pt)
02EC-11	Beaver River	32,672.45		
02EC-12	Anson Creek	25,036.86		
02EC-13	Kahshe River	24,572.25	2EC-16	Kahshe River
02EC-14	Holland River East Branch	22,374.30		
023C	South Georgian Bay Shoreline (part)	22,000 (Approx)	2EB-02 (part) 2EC-17 (part)	Moon R (part) Severn R (part)

*** Columns 1-3 (from left) are downloaded from the Ontario Watershed Boundaries list at https://www.arcgis.com/home/item.html?id=0391524acaa64dad9d0eba7efbb6794d#data. Columns 4-5 are based on a comparison with earlier data. The total area of Watershed 023C is 338,370 ha of which approximately 22,000 ha lie within the District Municipality of Muskoka.*

With few exceptions, and to the extent that mapping data permit, official watershed boundaries are natural, ecological boundaries. It makes sense to report on environmental health using these natural boundaries instead of municipal boundaries. In this Report Card, MWC reports on environmental health at the quaternary watershed scale where possible. The Muskoka watersheds cover a large area and pressures on environment vary from place to place within them. However, many indicators do not lend themselves to being examined at the quaternary watershed scale, the effects of climate change are one obvious example. For other indicators there is insufficient data available for some of the more remote quaternary watersheds. In these cases, the evaluations must be Muskoka-wide, or for some of the quaternary watersheds only.

THE MUSKOKA RIVER WATERSHED, NO. 02EB

The Muskoka River Watershed (02EB) is located in central Ontario lake country. The main population centres are Huntsville, Bracebridge, and Gravenhurst. Both Highway 400 and Highway 11 bisect the Watershed in a north/south direction. The general characteristics of the Muskoka River Watershed are provided in Table 3.

Table 3. Watershed characteristics of the Muskoka River Watershed (02EB).

Characteristic	Value
Watershed Area	5,423 km^2
Approximate Permanent Population*	69,000
Approximate Seasonal Population*	96,000
Number of Major Towns	3 (Bracebridge, Gravenhurst, Huntsville)
Number of Villages and Hamlets	11
Number of Quaternary Watersheds	14
Number of Lakes	Over 1,000
Number of Municipal Wastewater Systems	8
Number of Water Control Structures	42
Number of Navigation Locks	3
Number of Hydro Generating Stations	10

** Permanent population estimates based on Canadian 2021 census data for municipalities with municipalities that straddle watersheds divided accordingly. Seasonal population estimates based on published estimates by the District Municipality of Muskoka, Seguin Township, and the Township of Algonquin Highlands and set equal to estimated permanent populations for other municipalities; municipalities that straddle watersheds divided accordingly.*

From its headwaters in Algonquin Provincial Park, the Muskoka River flows 210 km through a series of connecting lakes to two outlets in Georgian Bay. The watershed is 62 km at its widest point, encompasses an area of approximately 5,423 km^2, and includes about 780 km^2 of lakes. The watershed is divided into three distinct sections: the north and south branches of the Muskoka River, and the lower Muskoka River, Moon and Musquash Rivers. The north and south branches of the Muskoka River comprise approximately the eastern two-thirds of the watershed, originating in the highlands of Algonquin Provincial Park. They flow south-westerly until converging in Bracebridge and then flow into Lake Muskoka. The lower portion of the watershed covers approximately the western one-third of the watershed and receives the inflow from the north and south branches of the Muskoka River as well as Lakes Muskoka, Joseph, and Rosseau. This combined flow passes through the Moon and Musquash Rivers and discharges into Georgian Bay. The watershed is bounded to the west by 023C, South Georgian Bay Shoreline.

THE SEVERN RIVER-LAKE SIMCOE WATERSHED, NO. 02EC

The Severn River-Lake Simcoe Watershed (02EC) encompasses an area from Newmarket in the south to Minden in the north and Honey Harbour in the west. It includes all of Lake Simcoe in addition to the Black and Severn Rivers. This Report Card concerns only 1,212 km^2 of the northern portions of the watershed.

The headwaters of the Black River are in the Township of Algonquin Highlands. From there, the river flows in a south-westerly direction through the southern portion of the District of Muskoka and northern portions of the Township of Minden Hills, City of Kawartha Lakes, and Ramara Township to Lake Couchiching. From Lake Couchiching, it enters the Severn River and flows to Georgian Bay. Most of the land area in the Black River Watershed is Crown land, with the upper reaches being part of the old Leslie M. Frost Centre.

The portion of the Severn River Watershed that flows through the southern portion of Muskoka is the very bottom section of the Trent/Severn Waterway. The water flows from Lakes Simcoe and Couchiching into the lower Severn River and out to Georgian Bay at lock 45 at Port Severn. The Kahshe River Quaternary Watershed flows into the Severn River.

The portion of the Severn River-Lake Simcoe Watershed included in the Report Card is sparsely populated (less than 63,000 total residents) with few large urban or agricultural areas. The land use tends to be a blend of rural residential and Crown land settings where population dramatically increases for the summer months because of a vibrant tourism industry and

seasonal residents. The characteristics of the Severn River-Lake Simcoe Watershed are outlined in Table 4.

Table 4. Watershed characteristics of the Severn River-Lake Simcoe Watershed (02EC). Values in brackets are for the portion of the watershed covered by this Report Card.

Characteristic	Value
Watershed Area	4,463 km^2 (1,570 km^2)
Approximate Permanent Population	(30,500*)
Approximate Seasonal Population	(32,200*)
Upper-Tier Municipalities	4 (1)**
Lower-Tier Municipalities	9 (5)
Number of Quaternary Watersheds	14 (5)
Number of Lakes	Over 500

** Permanent population estimates based on Canadian 2021 census data for municipalities with numbers for municipalities that straddle watersheds divided accordingly. Seasonal population estimates based on published estimates by the District Municipality of Muskoka, and the Township of Algonquin Highlands and set equal to estimated permanent populations for other municipalities; numbers for municipalities that straddle watersheds divided accordingly.*
*** One single-tier plus three upper-tier municipalities.*

The Severn River-Lake Simcoe Watershed flows through portions of three upper-tier municipalities (Simcoe, Muskoka, and Haliburton), one single-tier municipality (City of Kawartha Lakes) and nine lower-tier municipalities (Gravenhurst, Bracebridge, Lake of Bays, Muskoka Lakes, Georgian Bay, Minden, Algonquin Highlands, Severn and Ramara).

The Severn River-Lake Simcoe Watershed is part of the Trent-Severn Waterway. As such, water levels and water flows throughout the watershed, including portions of the lower Black River, are managed by Parks Canada, an Agency of Environment Canada.

WATERSHED USE

The Muskoka watersheds support a wide range of aquatic and terrestrial ecosystems. Numerous human uses, including recreational activities such as swimming, canoeing, boating, angling, hunting and trapping, and industrial uses such as; waterpower generation, farming, timber harvest, and mining of gravel and dimensional stone occur within these ecosystems. There are

over 42 water control structures (dams and/or dam/powerhouse combinations) on the Muskoka River system and three navigation locks.

PAST INDICATORS OF WATERSHED HEALTH

Since the first Muskoka Watershed Report Card was issued in 2004, considerable information about our watershed has been gathered and assessed and environmental knowledge has advanced. Over the years, the Muskoka Watershed Report Card has evolved significantly and, over time, a variety of indicators have been used. Effective indicators are best chosen as a result of data availability, science advancements, and improved methodologies reinforced by expert scientists. Most watershed health indicators used in report cards have been modified over time.

For example, in past report cards, total spring surface water phosphorus was evaluated and reported, usually using the provincial guidelines. Provincial guidelines have changed over time, as well as how we analyze the data to determine grades, so while the indicator remains the same, it has been analyzed differently from one report card to the next. These changes have been due to advances in the underlying science. Consequently, values reported in the 2023 Report Card are not always easily compared to values of that indicator in an earlier report card.

In some earlier report cards, MWC attempted to average values for indicators to achieve an overall grade for the environment. That practice was abandoned in 2018. In the 2023 Report Card values for specific indicators are reported separately. Each is an indicator of a unique aspect of watershed health.

INDICATORS USED IN THE 2023 MUSKOKA WATERSHED REPORT CARD

Decisions on indicators to use in the 2023 Report Card commenced with a review of the eight indicators used in 2018. Six of them were examined at a quaternary watershed scale. All eight are included in 2023, although the way they are treated has changed in several ways. Species at risk and invasive species are reported on, but data are now considered inadequate to use these as quantitative indicators of the state of our biodiversity. Climate change has been evaluated in three ways, two new this year. Three new indicators, chloride in lakes, frequency of algal blooms, and status of fishery species have been introduced. The final chapter asks, "What is watershed health?" and explores the concept of *ecological integrity,* the term preferred by ecologists evaluating ecosystems. This chapter is an introduction to the dynamic, living nature of watersheds. Altogether, the 2023 Report Card includes six indicators examined at a quaternary watershed scale and five others reported on for the Muskoka watersheds overall as well as the

discussions of bird populations, Beech bark disease, and ecological integrity. These 14 topics provide the data that underlie this year's Report Card (Table 5).

Table 5. Topics (mostly specific indicators) used to assess the health of the Muskoka watersheds in 2023. Italics = indicator used in 2018.

Indicator	Aquatic/Terrestrial	Quaternary scale	Comments
Calcium	Aquatic	Yes	Surface water calcium
Phosphorus	Aquatic	Yes	Spring surface water phosphorus
Benthic Macroinvertebrates	Aquatic	Yes	Percentage of sensitive species
Chloride	Aquatic	Yes	Spring surface water chloride
Fish populations	Aquatic	No	Fishing regs being changed because of changing conditions
Algal Blooms	Aquatic	No	The frequency is increasing
Interior Forest	Terrestrial	Yes	Percentage of total forest
Fragmentation	Terrestrial	Yes	Loss of large forest patches
Bird Populations	Terrestrial	No	A potential indicator if data can be assembled
Invasive Species	Both	No	Known invasives in the region
Beech Bark Disease	Terrestrial	No	Case study of the complex remediation required to deal with this invasive pathogen
Species at Risk	Both	No	Are these being well managed?
Climate Change	Both	No	Trends in weather detected, also environmental changes being detected
Ecological Integrity	Both	No	Why important, how to measure

Decisions on indicators to use and how to use them required careful consideration of data availability, recommendations from scientists, and a desire to include a broad range of aspects

of environmental health. This Background Report also includes suggestions for improving the data in future years. Indicators were also chosen with the intention of creating a consistent, easily understandable foundation for incorporating new evidence in future reporting.

Indicators of ecological health are most meaningful and effective if interpreted together because all aspects of the environment are linked (Briggs, 1999). In this way, they serve much like the blood work and other diagnostic tests routinely used by medical professionals when assessing health of a patient. Just as there is not a single test for overall human health, there is no test yet available that measures overall environmental health. Our discussion of ecological integrity in Chapter 14 examines this issue.

Calcium (Ca) is an important nutrient for all organisms and is required for the development of bones and exoskeletons. As a result of acid precipitation, calcium has leached out of the forest soils and is now in decline in many of the lakes in the watershed. In some lakes, calcium levels are low enough to stress species like *Daphnia,* an important zooplankton species at the bottom of the food chain. Calcium is evaluated at a quaternary watershed scale.

Total Phosphorus (TP) is a measure of the amount of phosphorus present in a waterbody. Typically, it is measured in surface waters in the spring while lake water has not yet stratified. Because it is an essential nutrient, the amount of phosphorus present is one guide to how productive a lake can be. Higher amounts of TP may increase the likelihood that a waterbody will experience excessive aquatic plant growth and/or a nuisance algal bloom. Phosphorus is evaluated at a quaternary watershed scale.

Benthic Macroinvertebrates (BMIs) are the numerous larval insects and other small animals living on or in the sand or mud at the bottom of lakes or rivers. They are used as biological indicators of water quality and habitat conditions. Different species have different tolerances to pollution or disturbance, so the presence or absence of sensitive benthic species can provide an indication of water quality. They are evaluated at a quaternary watershed scale.

Chloride (Cl): Our waters are naturally low in dissolved salts (chloride), but our road-management activities introduce salt to the environment and that salt can impact nearby forests and lakes. Chloride concentrations in most lakes in this region are now much higher than in the past. This elevated chloride level may negatively affect some important aquatic species. Chloride concentration in lake waters is a new indicator in 2023 and is evaluated at the quaternary watershed scale.

Fish Populations: Fish play important ecological roles in our lakes and rivers. Sportfish sustain an important recreational fishery and the Ministry of Natural Resources and Forestry is responsible for managing this fishery sustainably so that species will remain present into the future. We do not report on the status of particular fish species for this Report Card. Instead, we report on the revision to fishery regulations that is being carried out across Ontario, and the reasons why a revision has been necessary. This is a story of a changing environment for fish in the Muskoka watersheds that is reducing the capacity of certain species to survive and reproduce, while benefiting other species. Another new indicator for 2023.

Algal Blooms: There is general concern in this region that the occurrence of algal blooms, particularly of the potentially toxic blue-green algae, is increasing in our region. The number of confirmed reports of algal blooms each year is another new indicator in 2023.

Interior Forest habitat is forest habitat at least 100 m from a forest edge. Interior forest is buffered from external disturbances by that 100 m of surrounding forest. Interior forest supports a wide variety of forest-dependent wildlife that do not live closer to forest edges; it's an important habitat for sustaining overall biodiversity. The proportion of interior forest is an indicator of the quality of our forested land and is evaluated at the quaternary watershed scale.

Fragmentation occurs when a new road, hydro corridor or similar disturbance cuts through a forest and divides a large natural area into smaller pieces. As development occurs, fragmentation increases. As patches of habitat become smaller, biodiversity declines because many species lack adequate space to carry out their lives. How our watersheds are developed will dictate their health in the future. Fragmentation is analyzed at the quaternary watershed scale.

Bird Populations: Available data are inadequate to use birds as indicator species this year but if more reporting of species occurs, they can become a valuable terrestrial indicator of biodiversity decline or forest fragmentation in future report cards.

Invasive Species are plants, animals, and micro-organisms that out-compete native species for habitat and resources when they arrive in habitats outside their natural range. Invasive species can significantly reduce the biodiversity of an area. Invasive species have been an indicator in past report cards, but there are problems with data reliability. Also, many invasive species have managed to move quite quickly across our region. We also identify the invasives currently known to be present and how to report invasive species when you find them.

Beech Bark Disease: The story of Beech bark disease is included as an example of the complex habitat-scale impacts, and difficult remediation required to deal with this invasive pathogen.

Species at Risk are plants and animals that have been evaluated and are declared to be threatened with extinction, extirpation, or endangerment in a region. These species are at risk because of various natural and human-induced threats they may face. These species contribute to biodiversity, which is important for a healthy watershed. As in 2018, we do not report details of occurrence at a quaternary watershed scale because, unfortunately, some people use information about the presence of rare species to collect them for the (illegal) pet and curio trade. Instead, the status of species at risk is more broadly discussed including the question of whether enough is being done to sustain their populations.

Climate Change is already here and is having significant impacts on the Muskoka watersheds. The 2018 Report Card presented changes in the duration of winter ice cover on lakes as an indicator of climate change. In 2023 those data are updated, and we add information on trends in air temperature, patterns of precipitation, and the link between storms and floods. All these trends are likely to continue as the planet warms. Implications for environmental health are discussed.

Ecological Integrity is a measure of the capacity of an ecosystem to be resilient when stressed by changing environmental conditions. Ecological integrity is therefore an important measure of the capacity of our environment to withstand changes being caused by increased development and use or by climate change and other factors. There is no simple measure of ecological integrity, and yet ecological integrity comes closest to what we mean when we speak about environmental health. We discuss it, because understanding ecological integrity helps one understand that the ecosystems that comprise our environment are complex, multi-dimensional ecological systems that respond to stressors of different kinds in multiple ways. We must use the precautionary principle when dealing with such complex systems.

BENCHMARKING

For some indicators, with quantitative data at the quaternary watershed scale, indices of health are calculated at that finer scale by setting benchmark values of the indicator representing *not stressed, vulnerable,* and *stressed* states. We report details of how the benchmarks are determined.

The benchmarks are based on the best available science and keyed to typical Muskoka environmental quality. In other words, the division into *not stressed, vulnerable,* and *stressed* is appropriate to the generally high-quality environment found in Muskoka. Muskoka's benchmarks are typically higher than those used in southern Ontario where, on average, environments are more degraded.

The remaining indicators either provide assessments of health at the tertiary watershed scale or provide no quantitative assessment because of data inadequacy. Whether at quaternary or tertiary watershed scale, we have looked in this Report Card for evidence of trends in health over time. Where degradation is apparent, it is important to consider management actions to restore watershed health: acting sooner can be much more effective than acting once a crisis point is reached.