



Natural Systems Monitoring & Reporting: Program Review and Update



May 2023

“What gets measured gets managed.”

Peter Drucker, management educator and consultant

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“No one steps in the same river twice, for it is not the same river and they are not the same person.”

Heraclitus of Ephesus, philosopher



Abbreviations

CA: Conservation Authority

CBLWQ: City Baseline Water Quality monitoring program

CSW: City Stream Watch

FWIS: Flowing Waters Information System

MECP: Ministry of the Environment Conservation and Parks

MNR/MNRF: Ministry of Natural Resources and Forestry

MOU: Memorandum of Understanding

MVCA: Mississippi Valley Conservation Authority

MRWP: Mississippi River Watershed Plan

MRWMP: Mississippi River Water Management Plan

OFAH: Ontario Federation of Anglers and Hunters

OSAP: Ontario Stream Assessment Protocol

PGMN: Provincial Groundwater Monitoring Network

PSW: Provincially Significant Wetland

PWQMN: Provincial Water Quality Monitoring Network

1.0 Why We Monitor Natural Systems

The monitoring and analysis of data and identification of trends are fundamental business practices across multiple sectors, including the field of resource management. Tracking natural system conditions allows for achievement of several objectives including:

- Assessment of the current health of the watershed
- Identification of trends and predictive analysis of changes in natural systems
- Use of local field data when considering permit and planning applications
- Information sharing with municipal planners, engineers, and decision-makers
- Information sharing with residents, businesses, and funders
- Planning, design, and targeting of mitigation and adaptation strategies
- Assessment of the efficacy of those strategies over time

The purpose of this report is to present findings of a recent review of the natural system monitoring and reporting program at Mississippi Valley Conservation Authority (MVCA) and to present changes for implementation over the next five-year period. The monitoring plan covers the entirety of MVCA's jurisdiction: the Mississippi River watershed (~3,750 km²), Carp River watershed (~306 km²), and approximately 263 km² of land that drains directly to the Ottawa River between Marshall's Bay and Shirley's Bay.

Note, the scope of this review does not include water quantity monitoring (water levels and flows), which is conducted per the *Mississippi River Water Management Plan (MRWMP)*.

2.0 Updating Monitoring Programs

Periodic review of monitoring programs is needed to ensure they keep abreast of current standards and meet the evolving need of users. Consideration should be given to the following matters when reviewing a natural system monitoring program, including:

- Who needs the data and for what purposes? For example:
 - Water quality monitoring for protection of public health and safety
 - Baseline conditions for use in environmental impact assessments and trend analysis
 - Environmental effects monitoring for mitigating impacts
 - Targeted monitoring to address specific locations, species, or pollutants.
- What sample collection and analytical methods and protocols are required?
- Are other data sources available to avoid duplication and consolidate data sets?
- How will geographic, seasonal and other variability be addressed?
- What skills and expertise and specific training and equipment are required?
- Are there site accessibility or health and safety issues to be addressed?
- What frequency of reporting is needed by the end users?

3.0 Local Geography

A general understanding of MVCA's local geography is needed to understand and review the current monitoring program.

3.1 Geology

MVCA jurisdiction is comprised of two diverse physiographic regions: the Canadian Shield in the west and the St. Lawrence lowlands in the east, with a transition area between that combines the characteristics of the two regions (Figure 1).

The Western Shield Area:

- Comprises the upper two thirds of the Mississippi River, its headwaters and three main tributaries: the Clyde River, the Indian River and the upper part of the Fall River.
- Has a hummocky topography with shallow soils and rocky outcroppings that limits agricultural use.
- Predominately consists of contiguous expanses of natural areas with abundant forest cover (about 70%), hundreds of lakes and numerous small wetlands.
- Has a rural character with development scattered across rural holdings, concentrated in small villages and hamlets, and around the lakes.

The Eastern Lowlands Area:

- Includes the lower reach of the Mississippi River, the entire Carp River watershed (CRW), and the watersheds of several small tributaries to the Ottawa river to the east of the CRW.
- Is flatter with deeper fertile soils more suited to agricultural land use.
- Has smaller, fragmented pockets of natural areas (small forest patches, larger but fewer wetlands) within a mix of rural and urban land use.
- Urban development is concentrated in and around the City of Ottawa, Carleton Place, and Almonte, with rural estate-lot growth and severances in the surrounding municipalities.

3.2 Land Use

MVCA's jurisdiction encompasses portions of eleven municipalities. Each has a distinct character and economy, but with similarities within geographic regions (Figure 2).

The Upper Watershed is comprised of portions of Addington Highlands, Greater Madawaska, North Frontenac and Central Frontenac townships. This area has:

- large tracts of heavily forested Crown Land with a history of logging and mining.
- a wilderness character with growing recreational tourism.
- settlement concentrated in Sharbot Lake, small hamlets, and around some lakes.

The Middle Watershed is comprised of portions of Lanark Highlands, Tay Valley, and Drummond North

Elmsley townships. This area:

- is a transition zone between forest and farming, with farms interspersed between lakes, forests and wetlands.
- has significant lake and riverfront development with a growing year-round population and recreational tourism sector.
- also has population settlements in Lanark Village, small hamlets and along roads in areas with concentrations of rural severances.

The Lower Watershed is comprised of the Town of Carleton Place and portions of the municipality of Mississippi Mills, Beckwith Township, and City of Ottawa. This area:

- has a mix of urban and rural settlements, farmland, and lake and riverfront development interspersed by remnant forests and wetlands.
- comprises some of the fastest growing communities in Canada. The 2021 Statistics Canada Census marked Carleton Place as having the highest growth rate in the country between 2016 and 2021.
- has extensive artificial drainage systems and growing pressures on surface and ground water supplies.

3.3 Drainage Areas / Subwatersheds

Numerous smaller rivers and streams (tributaries) feed the Mississippi, Carp, and Ottawa rivers, and have significant influence on the health and functioning and the larger systems. Figures 2 and 3 illustrate key subwatersheds within MVCA's jurisdiction.

Figure 1: Division between On-Shield and Off-Shield

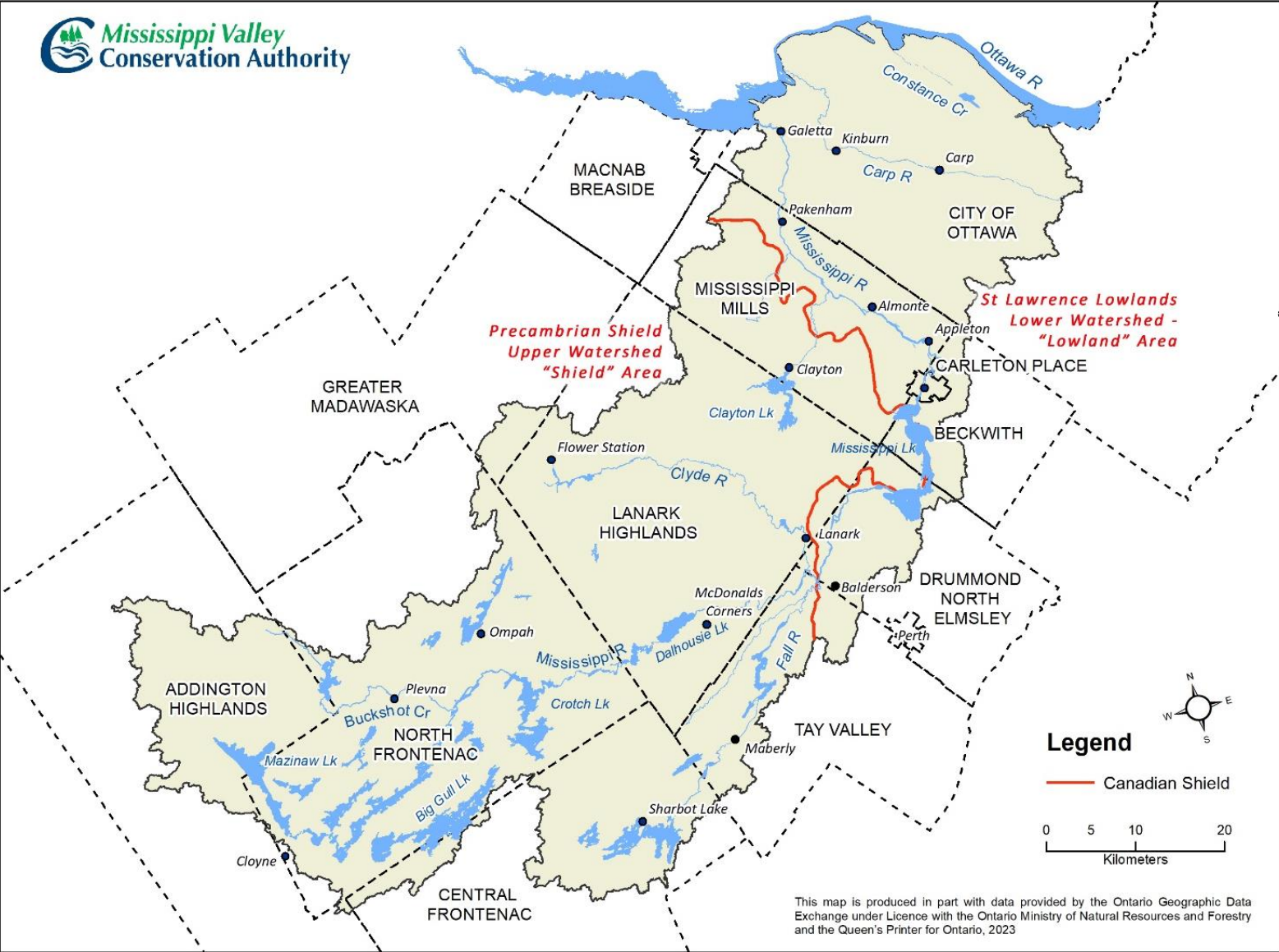


Figure 2: Upper, Middle and Lower Watershed with Major Subwatersheds

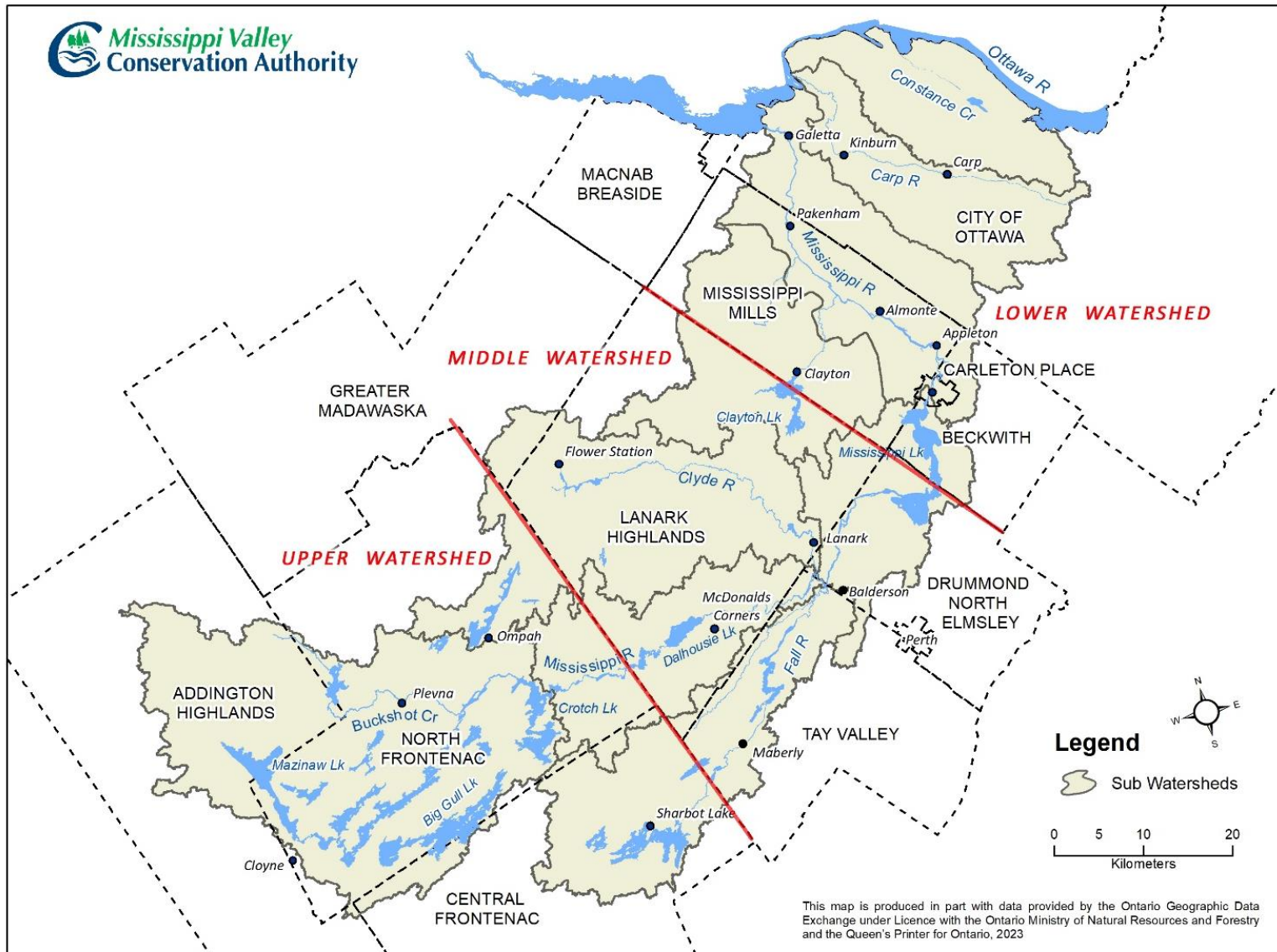
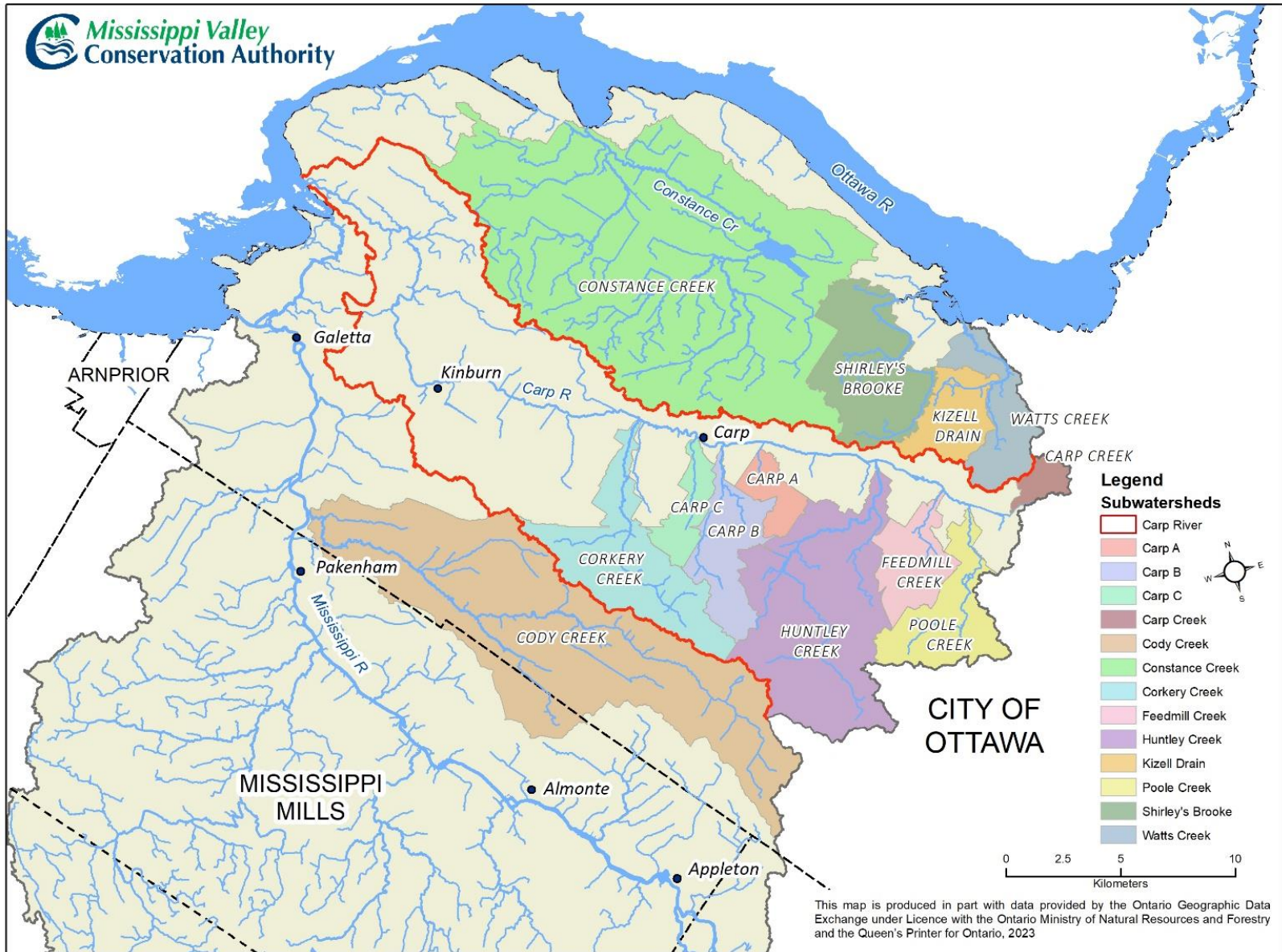


Figure 3: Subwatersheds on the Carp and Ottawa Rivers



4.0 Regulatory and Policy Context

Before reviewing opportunities to improve the existing monitoring program, it is important to understand the regulatory and policy context.

4.1 Conservation Authorities Act, 1990

The *Conservation Authorities Act* (CAA) provides for the “delivery of programs and services that further the conservation, restoration, development and management of natural resources...” To facilitate this, Section 21 of the CAA states that conservation authorities (CA) may “research, study and investigate the watershed to support the development and implementation of programs and services...” and Section 28 provides for the permitting of all development within regulated areas (hazard lands and wetlands). MVCA’s current monitoring program was developed within this context.

More recently, *Ontario Regulation 686/21* under the CAA prescribes activities that all CAs must undertake, which includes:

- **collecting and submitting samples for analysis** from wells, streams, and groundwater sites that are part of the Ministry of Environment Conservation & Parks (MECP) provincial groundwater and stream monitoring programs.
- **acting on behalf of the Ministry** of Natural Resources and Forestry (MNRF) to help ensure that planning decisions are consistent with natural hazards policies contained in the Provincial Policy Statement.

MVCA has been providing field service support to provincial monitoring programs since 1964 and compliance monitoring services since 2001. In order to fulfil these responsibilities, MVCA must ensure that it has the knowledge required to conduct reviews, which is obtained in part through monitoring, assessing, and mapping key attributes of the watershed.

The above activities are considered mandatory “Category 1” services.

4.2 Legislative Responsibility of Municipalities

Bill 26 and subsequent changes to the CAA and O.Reg. 596/22 place responsibility for reviewing and commenting on the natural heritage impacts of applications under the *Planning Act* exclusively with municipalities. Previously, CAs were permitted to provide comments to member municipalities using data collected via our natural systems monitoring programs.¹ As of January 1, 2023, it is the responsibility of municipalities to ensure that they have the data required to review and ensure compliance with natural heritage policies of the *Provincial Policy Statement, 2020* specifically:

- Section 2.1.2 “The diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features.”

¹ If not directly, then to the consultants of applicants.

- Section 2.2.1 That “planning authorities shall protect the quality and quantity of water” through a number of measures including: using the watershed scale to measure cumulative impacts of development, evaluating and preparing for the impacts of a changing climate to water resources, ensuring consideration of environmental lake capacity, etc.

At present, natural system monitoring programs that support the review of applications under the *Planning Act* are the following:

- Lake monitoring
- City Stream Watch inventories
- Ontario Stream Assessment Protocol (OSAP) monitoring
- Headwater monitoring
- Stream temperature monitoring
- Benthic and fish community monitoring

MVCA also integrates monitoring data that is received via Environmental Impact Studies (EIS) into its database. These reports include natural heritage data (wetland information, species present, other natural features present) and observational data on species and features on site. The data is spatially referenced in MVCA’s GIS system, with point data linked to attribute tables and is used to inform planning and regulations reviews.

Currently, these data collection and management services are funded using the General Levy. As they are used to support mandatory planning review functions of municipalities they will be considered “Category 2” programs going forward.

4.3 Mississippi River Water Management Plan (MRWMP)

The *Mississippi River Water Management Plan* is a provincially approved document that sets water management objectives and the operational and monitoring obligations of those who own water control structures in the Mississippi River basin. Under the MRWMP, MVCA is required to work with MNRF and MECP to:

- Monitor and maintain spring spawning opportunities for pike, walleye and bass.²
- Monitor Walleye spawning to ensure that fisheries on Crotch Lake and at the inlet to Dalhousie Lake are protected, as much as possible, during spring operations.
- Monitor Lake Trout spawning to assess long-term impact of operating regime on populations.
- Assess spawning shoal assessment annually or bi-annually in the fall using the standard provincial Spring Littoral Index Netting (SLIN) protocol.
- Monitor the assimilative capacity of the lower river system during low flow conditions.³
- Enhance hydrometric monitoring across the watershed.⁴

² Spawning opportunities are managed at the dams by providing a consistent flow during spawning season. MVCA monitors for spawning periods using water temperature at gauge stations.

³ This work is largely carried out by local municipalities discharging to the river, with MVCA providing review and comment on technical studies.

⁴ Hydrometric monitoring is carried out by the Engineering Unit and was not addressed in this program review.

- Monitor socio-economic variables particularly as they relate to recreational tourism.⁵
- Track water-taking permits in the watershed.⁶
- Engage with First Nations and review impacts of fluctuating water levels wild rice beds.
- Conduct shoreline surveys to identify areas of potential damage.

All the above activities are considered mandatory “Category 1” services, however, they are largely led by the province, with MVCA activities occurring at intervals.⁷ Clearer delineation of roles and responsibilities given the resource limitations of all three agencies is needed.

4.4 MVCA Corporate Strategic Plan

MVCA’s 2021-2025 *Corporate Strategic Plan*⁸ identifies several objectives that should influence the review and any changes to existing monitoring programs:

- Strengthen our risk analysis and management capacity to include climate change and development impacts.
- Implement priority actions identified in the *Mississippi River Watershed Plan*.
- Plan for the next phase of asset development and management.
- Demonstrate MVCA to be a trusted, client-centered, resourceful, and helpful partner.
- Strengthen relationships with municipalities and community stakeholders, First Nations, the agricultural sector, developers, not-for-profits, and academia.

4.5 Mississippi River Watershed Plan

The 2021 *Mississippi River Watershed Plan* (MRWP)⁹ was developed through extensive consultation with other levels of government and a cross-section of groups and individuals representing a broad range of interests. The Plan identifies growing concern over:

- current and future impacts of climate change
- more frequent and severe floods and droughts
- development pressure in waterfront areas
- rapid urbanization in the west end of the watershed
- impairment of water quality (i.e. warming, algae blooms, invasive species)
- impacts to natural features and systems (i.e. drying wetlands, changes in forest composition).

These stressors can have undesirable impacts on water quality, wetlands, forests and both aquatic and terrestrial ecosystems, which can impact drinking water supplies and recreational tourism.

The Watershed Plan highlighted the role that wetlands, certain forested areas, and groundwater recharge areas have in mitigating floods and droughts and building resiliency to climate change and

⁵ This work was carried out during update of the *Mississippi River Watershed Plan* (MRWP) and will be updated with subsequent updates of the Plan.

⁶ MECP issues and tracks these permits. MVCA used available information when updating the *Mississippi River Watershed Plan* (MRWP).

⁷ Fish assessments such as SLIN and BsM are done by MNRF on a rotational basis.

⁸ <https://mvc.on.ca/wp-content/uploads/2021/07/2021-2025-Corporate-Strategic-Plan.pdf>

⁹ https://mvc.on.ca/wp-content/uploads/2022/03/MVCA-MississippiWatershedPlan_Final.pdf

development impacts. It also recognized the value of environmental monitoring in tracking and assessing those changes and their impact on the watershed environment and communities. Appendix A - Table A of the Watershed Plan provides a list of MRWP recommended actions pertaining to natural system monitoring efforts.

4.6 Mississippi-Rideau Source Protection Plan

The *Mississippi-Rideau Source Protection Plan*¹⁰ (MRSP) identifies several risks to municipal (and other) drinking water supplies. These can be generally divided into two types as shown in Table 1:

Point Source: usually site specific with a designated point of discharge that can be monitored by the owner/operator for environmental compliance and effects.

Non-point Source: associated with a variety of land uses where discharges are not discrete and focused, but occur over a broad area and are less easily traced and monitored.

While designed to protect municipal drinking water supplies, the MRSP risk analysis can also be applied to private individual wells and surface water intakes. Not listed above are toxicity risks to water used for consumption, bathing, and recreation arising from blue-green algae¹¹ die-off.

Table 1: Threats to Drinking Water¹²

Point Source	Non-point Source
<ul style="list-style-type: none"> • Waste Disposal Sites • Sewage Works¹³ • Road Salt and Storage of Snow • Dense Non-aqueous Phase Liquids (DNAPLs) and Organic Solvents • Fuel • Aircraft De-icing • Aquaculture 	<ul style="list-style-type: none"> • Commercial Fertilizer • Pesticide • Outdoor Livestock Areas (<i>e coli</i>) • Agricultural Source Material (ASM) • Non-agricultural Source Material (NASM) • Transportation Corridors

¹⁰ https://www.mrsourcewater.ca/images/Documents/Mississippi-Rideau-Source-Protection-Plan/Text/Mississippi-Rideau_SPP.pdf

¹¹ Cyanobacteria.

¹² These pollutants can be released at a single point or over wide areas. This table is intended to show the most likely source within the watershed.

¹³ This could include septic systems and pit latrines.

5.0 MVCA's Current Monitoring Program

MVCA's monitoring, reporting and stewardship programs currently focus on water quality. The current monitoring program collects data on lake, stream and river surface water quality indicators through a variety of standardized programs. In the west shield area, the focus is largely on lake monitoring, and in the eastern lowlands the focus is on stream monitoring, with additional monitoring occurring within the City of Ottawa under a special levy. The remainder of the programs are applied throughout MVCA's jurisdiction.

Existing monitoring and reporting services are summarized in Tables 2 and 3, with existing sites illustrated in Figure 4. The information collected through MVCA's monitoring program is shared with provincial, federal, academic and public partners.

5.1 Staff Expertise and Resources

MVCA has a full-time Aquatic Biologist who designs, oversees, and leads delivery of the Natural Systems Monitoring Program. Our biologist is certified to conduct wetland evaluations, electrofishing, benthic collections, and has an Ontario Boating License.

Each year, at least two summer students are hired from May to August to support seasonal data collection. When available, MVCA planning and regulations technicians provide monitoring program support, particularly during the shoulder seasons. For health and safety reasons, all monitoring site visits are carried out by two people (except to download PGMN dataloggers, or when meeting with lake steward volunteers).

MVCA has a canoe as well as a boat with outboard motor to collect lake samples, and regularly uses the following field sampling and analysis equipment:

- Digital probes: to assess basic surface water chemistry variables (pH, Dissolved Oxygen, Temperature, Conductivity, Turbidity)
- Digital dissolved oxygen and water temperature sensor: assess lake fish habitat conditions
- Secchi disk: determine lake water clarity and colour
- Kremmer bottle: collecting deep water discrete lake samples
- Backpack electrofisher: assess fish communities in wadable streams
- D-nets: collect benthic community samples

The Authority also has a lab that is capable of storing water samples before they are sent to accredited chemistry labs for analysis. Biotic samples (fish and invertebrates) can be stored until the off season for inhouse analysis.

Testing for the following water chemistry parameters must be sent to a private lab:

- Total Phosphorus
- Chlorides
- Metals

MECP pays for analysis of water samples collected from 14 sites (12 within MVCA and 2 that are outside of CA jurisdiction but near existing MVCA sites) under the PWQMN, and 9 sites under the PGMN programs. MVCA pays for all other analyses. In 2022, annual laboratory fees for external analyses was \$28604.24.

MVCA has also purchased 5 Water Ranger Water Testing Kits that are distributed each year to participating lake association volunteers. These kits allow for more regular analysis of the following parameters:

- Secchi depth
- Surface dissolved oxygen concentrations
- Temperature
- Conductivity
- Taking notes on invasive species or potential algae blooms

Table 2: Current Monitoring Programs

Type	Program <i>Data collected</i>	Program Partners	Reg. Cat. ¹⁴	Benefits
Stream	Provincial Water Quality Monitoring Network (PWQMN) <i>Water Chemistry</i>	MECP	1	<ul style="list-style-type: none"> • Long term record of robust, consistent data at key locations across watershed. • Consistent protocol across province. • Data useful for tracking long term changes, scientific research and modelling, and is widely used. • Province pays for chemical analyses, shipping and supplies the YSI sensor.
	City Baseline Water Quality (CBLWQ) <i>Water Chemistry</i>	City of Ottawa	2	<ul style="list-style-type: none"> • Long term record of robust, consistent data at key locations in City of Ottawa. • Consistent protocol across the City. • Data useful for tracking long term changes, scientific research and modelling. • The City pays for staff time, mileage and lab fees.
	MVCA WQ <i>Water Chemistry</i>	None	1	<ul style="list-style-type: none"> • Long term, continuous record of data that is easily merged with PWQMN data. • Locations chosen to fill gaps in PWQMN. • Data useful for tracking long term changes, scientific research and modelling, and is widely used. • Cost effective as an add-on to PWQMN (MVCA covers lab fees).
	Ontario Stream Assessment Protocol (OSAP) <i>Aquatic vegetation, fish, benthic macroinvertebrates and land use</i>	MNRF, FWIS	2	<ul style="list-style-type: none"> • Level of detail provides for stream characterization. • Data useful for long term monitoring of trends, and informing planning and regulations reviews. • Standardized protocol allowing assessment within a broad provincial context.

¹⁴ Regulatory Category per Section 21 of the *Conservation Authorities Act* and *O.Reg 686/21*.

Type	Program Data collected	Program Partners	Reg. Cat. ¹⁴	Benefits
	City Stream Watch <i>Land use, riparian and stream characteristics</i>	RVCA, SNCA	2	<ul style="list-style-type: none"> Provides for detailed record and assessment of stream conditions within urban areas. Associated reporting useful for planning/development review. Excellent information to target stewardship efforts. Cost effective to implement if done with community volunteers.
	Headwaters <i>Morphology and flow characteristics</i>	RVCA, FWIS	2	<ul style="list-style-type: none"> Provides seasonal details for habitat classification of stream reaches. Supports the implementation of management recommendations through the development process. Informs planning and regulations reviews.
	Stream Temperature Monitoring	MRNF, FWIS	2	<ul style="list-style-type: none"> Easy and cost effective to implement. Data needed for stream classification of cool and cold-water systems and supports the protection of sensitive habitats. Potential indicator of changes in water quality and/or climate change impacts. Informs planning and regulations reviews.
Lake	Lake Monitoring <i>Parameters related to trophic status</i>	Lake Stewards (volunteers)	2	<ul style="list-style-type: none"> Focus is on populated main stem lakes, secondary lakes are representative of sub catchments, and highly sensitivity lakes. Beneficial for observing general trends in lake trophic status. Program and data are greatly valued by lake communities. A primary tool to support lake community education and outreach. Informs planning and regulations reviews.
	Seine Netting <i>Near shore fish population</i>	Lake Stewards	3	<ul style="list-style-type: none"> Fills data gaps on the presence of nearshore non-sport fish species. Program and data are valued by lake communities. A tool to support lake community education and outreach.
	Lake Water Temperature	None	1	<ul style="list-style-type: none"> Easy and cost effective to implement. Potential indicator of changes in water quality and/or climate change impacts. Program and data are greatly valued by lake communities.

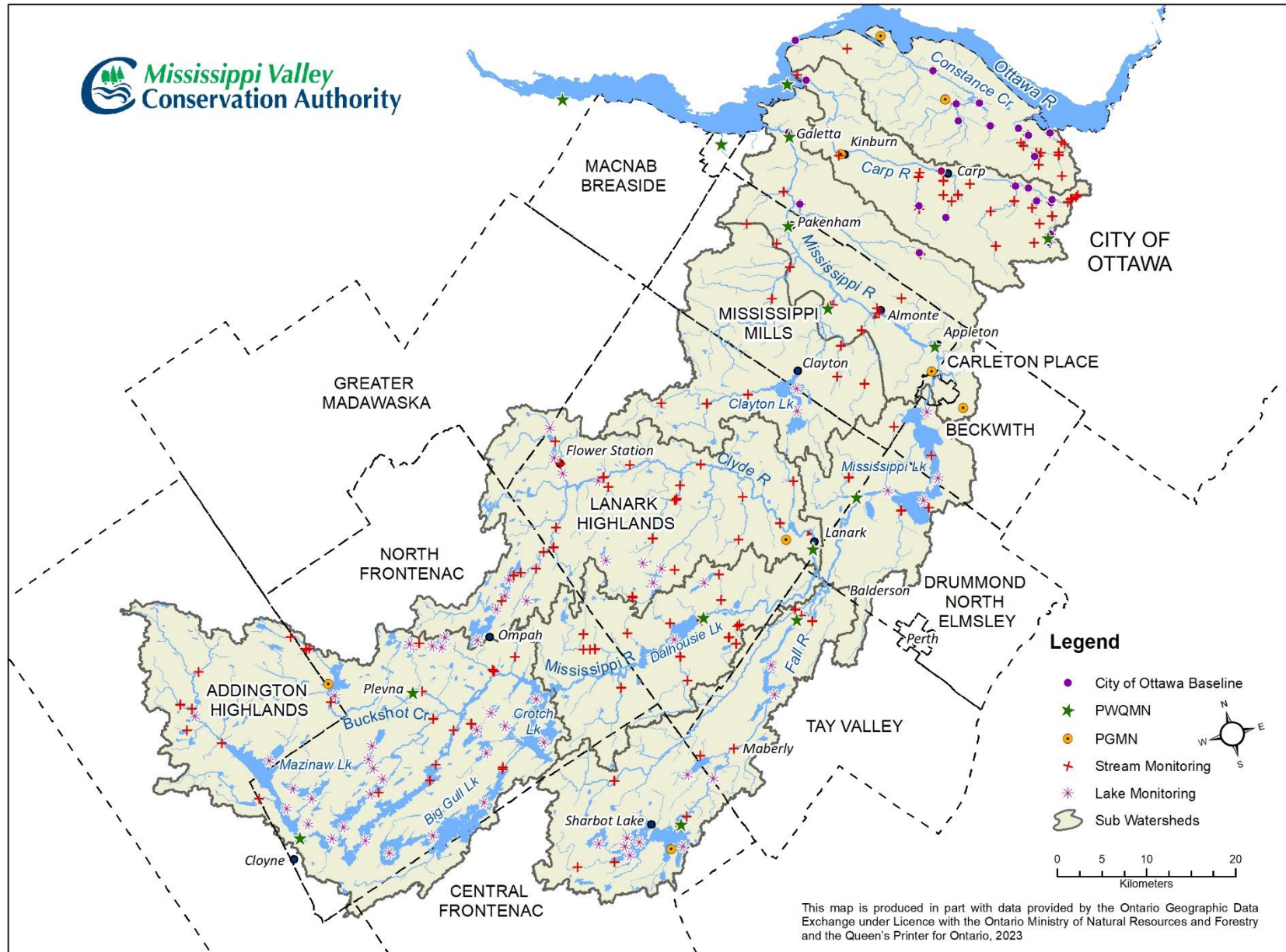
Type	Program <i>Data collected</i>	Program Partners	Reg. Cat. ¹⁴	Benefits
	Algae Monitoring <i>Incidental observations</i>	None	3	<ul style="list-style-type: none"> • Important information where there is little current or historic documentation of algae. • Potential indicator of changes in water quality and/or climate change impacts. • Information of interest to waterfront communities/ residents. • Easy and cost effective to implement.
Groundwater	Provincial Groundwater Monitoring Network (PGMN) <i>Water level and chemistry</i>	MECP	1	<ul style="list-style-type: none"> • Developing a long-term record at key locations across watershed. • Consistent protocol across province. • Data useful for tracking long term changes, and scientific research and modelling. • Province funded (except MVCA staff time). • Potential indicator of changes in water quality and/or climate change impacts. • Provides some data where there is an overall lack of groundwater information.
Invasive Species	Invasive Species Hit Squad <i>Incidental observations</i>	OFAH	3	<ul style="list-style-type: none"> • Incorporates community education/outreach events. • Potential indicator of changes in water quality and/or climate change impacts. • Information of interest to waterfront communities/residents. • OFAH funds summer student wages.

Table 3: Current Reporting Programs

	Frequency	Data Reported	Source of Information	Scale	Product Format and Benefits
Watershed Report Card	Every five years	Surface Water Quality	PWQMN, CBLWQ	Entire watershed area presented by subwatershed	<ul style="list-style-type: none"> • A watershed scale report produced every 5 years that grades the state of the watershed using five key indicators (surface water quality, wetland cover, forest cover, riparian cover and lake health) using a province-wide template and grading system. • Summary pamphlet plus a full report (approx. 40 pg.) using standardized Conservation Ontario template. • Useful for broadly raising awareness with an easy to read document that is well promoted through Conservation Ontario and all of the CAs. • Standardized grading allows for all 36 CAs to measure watershed conditions relative to each other.
		Groundwater Quality	PGMN		
		Forest Cover	ArcMap GIS Data		
		Riparian Cover	ArcMap GIS Data		
		Wetlands	ArcMap GIS Data		
		Lake Conditions	Lake Monitoring		
Integrated Monitoring Reports (Mississippi River Subwatersheds)	One report per year on a five-year rotation	Water Quantity	Stream flow and staff gauges, rain gauges, snow course data	Subwatershed (usually report on 2 subwatersheds per year)	<ul style="list-style-type: none"> • Sub-watershed scale reports produced annually that are monitored on a 5-year rotation • Reports report on lake and stream data with each year focusing on a single subwatershed. Presented as ~40-page report. • Provides a good snapshot of both overall subwatershed conditions as well as lake level results. • Provides some additional assessment of other conditions, such as seasonal weather and flow conditions that may have influenced data results.
		Water Quality	Lake Monitoring		
		Stream Assessments	OSAP		

City Stream Watch Reports (City of Ottawa Subwatersheds)	One report per catchment on a five-year rotation	Stream Morphology	Macro Stream Assessment Data	Report by stream catchment	<ul style="list-style-type: none"> • Subwatershed condition assessments of stream conditions in urban areas and future expansion areas, which are monitored on a 5-year rotation • Presented as 15 – 20-page report/catchment. • Provides information used to support review of planning applications. • Excellent tool for targeting stewardship efforts within the City of Ottawa. • Designed so that volunteers can be recruited to assist in monitoring, providing for education and outreach opportunities.
		Fish	Fish Sampling Data, OSAP		
		Benthics	OBBN Protocol		
		Temperature	OSAP		

Figure 4: Existing Monitoring Sites (2022)



6.0 Other Natural System Monitoring in the Watershed

The following sections summarize monitoring programs of other organizations.

6.1 Facilities Monitoring

Point source water and air withdrawals and discharges are monitored by facility¹⁵ owners and operators in accordance with their provincial licenses. Monitoring programs usually focus on planned withdrawals from ground and surface water, and discharges to ground or surface following a prescribed treatment process. They are intended to track compliance, identify incidents of non-compliance, and assess short and long-term environmental impacts. These data are not usually made available to the public unless prescribed by a license or part of a Corporate Environmental, Social and Governance (ESG) program. Water quality data is available from the Town of Carleton Place, Mississippi Mills, and City of Ottawa to support delivery of its mandate. These data provide detailed point-source bio-chemistry and other analyses on an almost continuous basis, but are not representative of the watershed.

6.2 Natural System Inventories and Monitoring for Land Development

Most approval agencies require Environmental Impact Statements (EIS) or Environmental Assessments (EAs) to be completed as part of their planning and review processes. Inventory data are largely obtained by specialists under contract to the applicant, provide a snapshot in time, and do not always capture seasonal differences and variations over time. Some consultants contact local CAs for more detailed and longitudinal data. Data contained in EIS and EAs are provided to approval agencies review, but are not always consolidated into a comprehensive data based for use by others. MVCA records key EIS findings to help build a composite understanding of proposals, mitigating measures, and impacts in areas of growth.¹⁶

6.3 Other Conservation Authority Programs

As noted previously, all 36 CAs participate in MECP's Provincial Water Quality Monitoring Network and the Provincial Groundwater Monitoring Network programs. Table 4 summarizes the scope of other monitoring programs carried out by a selection of CAs surveyed for this report.

MVCA consults with other CAs for program expertise and support as needed. By using similar protocols, CAs are able to provide their municipalities with comparable data and information. CA programs vary in the scope and focus due to differences in local landscapes, priorities, and resources.

¹⁵ For example, a sewage treatment plant, lumber mill, gravel pit, and plant manufacturing plant.

¹⁶ The file number and report author are recorded so more detail can be obtained if required.

Table 4: Scope of CA Monitoring Programs

Eastern Ontario Conservation Authorities	PWQMN	PGWN	City Baseline	Other W. Qual	Lakes	Shorelines	City Stream Watch	Stream Benthics	Stream Fish	Invasive Species
Rideau Valley	Y	Y	Y		Y		Y	Y	Y	Y
South Nation	Y	Y	Y				Y	Y	Y	Y
MVCA	Y	Y	Y		Y		Y	Y	Y	Y

6.4 Provincial and Federal Agency Programs

Natural resource management is a provincial responsibility under Canada’s *Constitution Act*, with primary responsibility for resource monitoring and assessment in Ontario residing with the Ministry of Natural Resources & Forestry (MNRF). In addition to the PGMN and PWQMN programs delivered by conservation authorities, the province directly¹⁷ and indirectly¹⁸ monitors fish¹⁹, wildlife and habitats for the purpose of setting harvest limits and land management objectives.^{20,21}

Provincial broad-scale fish (BsM) monitoring is to be carried out at a selection of lakes once every five years, however, coverage is sparse in MVCA’s jurisdiction.²² The province also prepares Forest Management Plans²³ for crown lands including the Mazinaw-Lanark forest.²⁴ These plans provide data regarding the condition of a forest and how it will be harvested and replanted over time.

At the federal level, monitoring and research are used to inform the drafting and update of federal policies and regulations to protect and conserve Canadian species and habitats from toxic substances, diseases, unsustainable commercial practices, climate change and other threats.²⁵ Environment & Climate Change Canada (ECCC) has primary responsibility, with other federal departments and agencies often responsible for self-monitoring.

¹⁷ <https://www.ontario.ca/page/broad-scale-monitoring-program#section-1>

¹⁸ E.g. <https://www.lioapplications.lrc.gov.on.ca/fishonline/Index.html?viewer=FishONLine.FishONLine&locale=en-CA>

¹⁹ E.g. https://www.publicdocs.mnr.gov.on.ca/fwsb/BsM/BsM-EN-Mississippi_Lake-FMZ18-Cyc03-18-4082-49908/BsM-EN-Mississippi_Lake-FMZ18-Cyc03-18-4082-49908.html

²⁰ <https://www.ontario.ca/page/natural-resources-science-and-research>

²¹ <https://www.ontario.ca/page/natural-heritage-information-centre>

²² This project considers the largest of MVCA’s lakes.

²³ https://nrip.mnr.gov.on.ca/s/fmp-online?language=en_US

²⁴ https://nrip.mnr.gov.on.ca/s/published-submission?language=en_US&recordId=a0z3g000000ofS9AAI

²⁵ <https://www.canada.ca/en/environment-climate-change/services/wildlife-research-landscape-science/research-topics.html>

The Mississippi Lake National Wildlife Area & Bird Sanctuary is the only federal site in MVCA's jurisdiction where monitoring is known to occur.²⁶ In 2022, Agriculture & Agri-food Canada carried out a herbarium inventory at MVCA's Morris Island Conservation Area.

6.5 Indigenous Knowledge

The Indigenous Peoples of Ontario hold valuable knowledge about the Watershed and may be able to help enhance the data we have collected and to assist in data interpretation. For example, in 2009 Plenty Canada assisted with an American Eel assessment by providing traditional knowledge and local insights. Plenty Canada has also recently undertaken projects to map Wild Rice in parts of the watershed.

When work began on the MRWP, MVCA undertook to prepare an Indigenous Engagement Plan (IEP) under the guidance of Cambium Indigenous Professional Services (CIPS). MVCA, through CIPS, will engage with Indigenous Communities/groups to discover any information sharing and potential collaborations in monitoring of environmental conditions. As initiatives are identified, MVCA will recommend amendments to the Natural Systems Monitoring Plan to the Board as well as seek funding to support these initiatives.

6.6 Other Organizations

6.6.1 Local universities

Both Carleton University and L'Université d'Ottawa have carried out short-term studies of specific species/habitats at MVCA properties, including migratory shorebirds, trilliums, dragonflies and turtles in recent years. There is occasionally a challenge obtaining final reports due to the timeframes involved to finalize projects.

6.6.2 Ontario Power Generation (OPG)

OPG sponsors bio-inventories at its sites, which in 2022 included initiating a yearlong bio-blitz at the Morris Island Conservation Area. This program was overseen by a professional biologist, as well as by other field specialists and volunteers. These data represent the current condition of the site, noting the presence of invasive species or species at risk, and can act as a benchmark to compare future site assessments to. The results from this project will be valuable to expanding our understanding of the site as well as nearby ecosystems. Events related to this bio-blitz will continue until the end of summer 2023.

6.6.3 Nature Conservancy of Canada, Ducks Unlimited, Ottawa River Keeper

The following is a summary of programs known to occur within MVCA's jurisdiction.

²⁶ They will be monitoring the amphibian populations and other habitat variables in 2023. This is a follow up to the 2021 season of their Protected Areas Wetland Monitoring Program.

- Nature Conservancy of Canada provides resources of pollinator habitat creation/restoration.
- Canadian Wildlife Federation also provides pollinator habitat resources, as well as turtle monitoring and habitat creation support. We are working with them to create two pollinator gardens at our properties.
- Ducks Unlimited provides wetland restoration/creation advice and funding programs. They often work directly with private landowners in our area.
- Ottawa River Keeper focuses on citizen science collection of data along the full Ottawa River Catchment. Recently, we have partnered on sharing water temperature monitoring efforts and share data where our zones overlap. Our monitoring programs do not overlap as we do not monitor the sites they do.

6.6.4 Volunteer Monitoring Programs

The following is a summary of volunteer programs known to occur within MVCA’s jurisdiction.

- Water Rangers is a citizen science-based program focused on monitoring surface water quality (streams and lakes) with simple parameters that can be done by volunteers onsite. MVCA promotes the program to lake communities and lends out equipment each season. Where in place, volunteers are able to gather data at more frequent intervals than MVCA staff.²⁷ Water Rangers has been adopted by several but not all lake associations.
- MECP’s Lake Partner Program²⁸ works with lake stewards who take an annual spring water sample for total phosphorus analysis at the MECP lab. The volunteers also take monthly Secchi depth readings. This program includes lakes that fall outside of MVCA’s lake program, but has gaps in that it only samples nutrients in the spring and does not include a dissolved oxygen-water temperature profile analysis.
- Watersheds Canada’s volunteer “Love Your Lake” programs provides waterfront property owners with shoreline assessments and stewardship recommendations.

The risk of becoming reliant on volunteer programs is a lack of year over year consistency due to waning interest, variable capacity, and volunteers aging out or burning out.

6.6.5 i-Naturalist, eBird, Eddmaps

Professional and amateur naturalists are encouraged to share their observations on websites such as I-Naturalist, eBird, Eddmaps etc. These data are generally *ad hoc*, variable in data quality, geographic and temporal representation, can show strong geographic and specie bias, and are limited by the skills of the participants. For these reasons they can be good to expand on a baseline program, but cannot be relied upon for providing broad geographical results over prolonged periods.

²⁷ MVCA staff monitor sites on a rotating basis, i.e. not every year; and will visit the site 3 times/year to support seasonal analysis.

²⁸ <https://www.ontario.ca/document/lakeshore-capacity-assessment-handbook-protecting-water-quality-inland-lakes/monitoring-lake-water-quality>

To make the most use of these data sets, search and filter functions can be applied to screen for quality and applicability. As well, where a citizen science program is implemented, programs can be designed that mitigate the limitations set out above.

7.0 Program Needs, Goals and Objectives

Based upon a review of the regulatory and operational needs of MVCA, municipal partners²⁹ and the information requested by residents and consultants over time, the following is a summary of the questions to be answered by MVCA's Natural System Monitoring and Reporting Program.

- What impacts are water control structures having on natural heritage features and functions and are mitigation measures working?
- What are baseline natural heritage conditions across the three watersheds, and how are conditions changing over time?
 - Water quality (surface and ground water for domestic and recreational use)³⁰
 - Aquatic and hydrophilic species (native and invasive)
 - Lakes and tributaries (headwaters and those experiencing growth pressures)
 - Forests and wetlands
- What are the potential causes of impairment where observed?
- How is climate change affecting natural heritage features and functions?
- What areas require targeted stewardship support and educational outreach?
 - To protect valued natural heritage features and functions.
 - To rehabilitate and restore degraded habitats.
- What impact do mitigation, stewardship, and compensation measures have in protecting existing landscapes, restoring impaired habitats, and replacing destroyed habitats?

Appendix 1 identifies how MVCA's current program and other monitoring programs address these requirements. This analysis distinguishes between (P)primary reliable data sources, and (S)econdary incidental data sources. Review of this table demonstrates the need for MVCA to continue its monitoring and reporting program, and to consider enhancing efforts to address information gaps.

7.1 Program Goals

Recommended goals of the Natural System Monitoring & Reporting Program are the following:

1. Provide municipal planners, MVCA staff, and other user groups with reliable and geographically representative baseline natural system data to support short and long-term

²⁹ To administer approvals under the *Planning Act*, 1990 in accordance with the *Provincial Policy Statement*, 2020

³⁰ Testing of individual supplies is the responsibility of Public Health. MVCA's role is confined to identification of trends in water quality and potential risks to the supply.

decision-making.

2. Identify and monitor the condition of sensitive natural features and functions, and vulnerable waterbodies.
3. Identify gaps in data sets and address gaps where resources allow.
4. Conduct specialized studies to address questions of concern (re: specific locations, species, or pollutants) where resources allow or on a cost recovery basis.
5. Analyze and report on current conditions, trends, threats, and opportunities to mitigate negative impacts on natural heritage features and functions.
6. Assess the efficacy of mitigation, stewardship and compensation measures.
7. Consolidate MVCA data with data from other sources to serve as the repository for natural heritage information within our jurisdiction.
8. Make data, meta data, and analyses easily accessible for all audiences and user groups.

7.2 Program Objectives

Recommended objectives of the Natural System Monitoring & Reporting Program are the following:

1. Use standardized protocols for monitoring, data management, and reporting that are consistent with partner agencies.
2. Deliver mandatory monitoring under the *Conservation Authorities Act*, namely the PWQMN and PGMN programs of MECP and tracking of wetland³¹ to fulfill Section 28 requirements.
3. Review monitoring requirements of the *Mississippi River Water Management Plan* with the province to confirm roles and responsibilities and expectations for effects monitoring of MVCA and other water control infrastructure. Adjust monitoring program, if required to address program gaps.
4. Optimize delivery of baseline water quality, habitat, and species monitoring programs to address geographic and temporal variability, include sensitive and vulnerable areas, and identify changes and trends over time.
5. Identify and determine means for addressing data gaps.
6. Develop a program for assessing the effectiveness of mitigation and compensation measures and MVCA's stewardship program, and integrate into annual workplans as resources permit.
7. Review and prioritize monitoring needs of the *Mississippi River Watershed Plan*, and integrate

³¹ Aerial photography is used to verify the presence, evolving shape, and destruction of wetlands over time.

into annual workplans as resources permit.

8. Conduct analysis and reporting at the watershed, subwatershed and stream levels, and across geographic regions: upper, middle and lower watershed.
9. Share MVCA data, and obtain partner organization data including provincial and federal agencies, academia, and non-government organizations (e.g. lake associations).
10. Collaborate monitoring efforts with other organizations to strengthen collective capacity, and leverage funding and cost-sharing opportunities.
11. Encourage community participation and use citizen science-based volunteer monitoring to increase MVCA's monitoring capacity, and maintain and enhance community relationships, stewardship, education and outreach.
12. Continue and enhance public education and the health of the watershed and what they can do as stewards of the watershed.

8.0 Current Program Challenges and Opportunities

A number of challenges have influenced delivery of the monitoring program in recent years. This section reviews the challenges, opportunities to address them and discusses ways to optimize monitoring across the watershed to ensure efficient use of limited resources to the areas of greatest need. Key challenges can be grouped into the following themes, which are reviewed in Tables 5, 6 and 7 below.

- Watershed size and diversity
- Limited staff and other resources
- Data management and use

Table 5: Watershed Size and Diversity

Key Considerations & Challenges	Objectives	Opportunities & Solutions
<p>Resources spread over a large and geographically diverse watershed.</p> <p>Development pressures concentrated in urban areas in the east, and waterfront areas in the west.</p> <p>Limited current monitoring within urban/developed areas outside of the City, (i.e. Carleton Place, Mississippi Mills and Beckwith).</p> <p>Hundreds of lakes in west – need to be strategic in determining which to monitor and the frequency.</p> <p>Overall lack of surface water quality and other monitoring in agricultural areas.</p> <p>Overall lack of groundwater quality data – implications in built up areas relying on private wells and septic systems.</p> <p>Carp Watershed and tributaries to the east show poor water quality results compared to the rest of the watershed.</p> <p>Forest cover (overall cover and interior forest cover) meets environmental targets³² in the west watershed but are at or below targets in the east.</p>	<p>Provide <u>long term</u> data sets from core representative sites.</p> <p>Focus monitoring to where it is most needed.</p> <p>Use standardized protocols.</p> <p>Collaborate with other organizations.</p> <p>Fill monitoring gaps where needed and reduce duplication/redundancy.</p>	<p>Priority on PWQMN, CBLWQ, and MVCA’s Lake Monitoring to: provide a long-term record of data from core sites, enable collaboration, and use standardized protocols (<i>on-going</i>).</p> <p>Assess monitoring needs specific to differing geography (<i>new</i>, Appendix A Figure 1 and Table 2).</p> <p>Lake monitoring was already revised to optimize sampling frequency concentrating on larger more developed lakes. There may be scope for further revision (<i>on-going</i>).</p> <p>Assess viability of additional water quality monitoring focused in agricultural areas (<i>new</i>).</p> <p>Assess groundwater data needs and solutions to augment data where need is identified (<i>new</i>).</p> <p>Support frequent updates to mapping/GIS products to enable assessment of forest and wetland cover, through partnerships and external funding opportunities (<i>on-going</i>).</p>

³² Based on Environment Canada “How Much Habitat is Enough” environmental targets.

Table 6: Staff and Resources

Challenges & Considerations	Objectives	Opportunities & Solutions
<p>Monitoring is coordinated by the staff biologist and carried out with the help of 1 to 2 summer students, and other staff as needed based on availability.</p> <p>Reliance on external funding to hire summer students – amount is not guaranteed from year to year.</p> <p>Reliance on sufficient core staff to complete the spring and fall work when students are not available (min. two required) with limited full-time staff trained in monitoring protocols.</p> <p>Wetland, Forest, and Riparian cover components of the Watershed Report Card are dependent on availability of updated mapping which is expensive to produce and analysis requires GIS time/expertise.</p>	<p>Efficient and cost-effective delivery of programs.</p> <p>Collaboration and partnerships to share resources.</p>	<p>Cross-train one or more full-time staff on monitoring protocols to provide assistance during peak periods and support data management during the off-season.</p> <p>At times, MVCA’s budget has supported hiring a monitoring technician to provide support to both monitoring and planning and regulations (periodic).</p> <p>Seek additional external funding/grants to support existing and new monitoring initiatives (on-going/new).</p> <p>Seek additional partnership arrangements to offset costs (new).</p>

Table 7: Data Management and Use

Challenges & Limitations	Objectives	Opportunities & Solutions
<p>Focus has been on the collection of data, with less time spent on the analysis, reporting and sharing of the data.</p> <p>Data is managed through MVCA’s WISKI system (program shared with other CAs). Requires significant staff training and ongoing use to be used efficiently.</p> <p>Continued loss of in-house WISKI expertise through staff turn-over.</p>	<p>Support land use planning and decision making.</p> <p>Support the actions of the Mississippi River Watershed Plan.</p> <p>Enable effective targeting of stewardship and restoration efforts.</p> <p>Support public education and outreach.</p> <p>Share data with broad range of partners (listed under 3.3).</p>	<p>Increased emphasis on the analysis, use, sharing and reporting of the data collected (ongoing/new).</p> <p>Standardize data storage formats and ensure staff training in use of WISKI (ongoing, through use of WISKI?).</p> <p>Make monitoring data publicly accessible through suitable formats (new).</p> <p>Standardized reporting formats to provide the public and other agencies with easily comparable data (on-going).</p> <p>More emphasis on volunteer-based citizen science programs, to heighten community interest and broaden the collection of baseline information (new).</p>

8.1 Geographic Priorities

As described previously, MVCA’s watersheds have marked physiographic differences in landform and associated ecosystems. This means that it is neither beneficial nor practical to have all monitoring programs applied equally across the MVCA’s jurisdiction. To help address this, a geographic assessment of the pressures, monitoring priorities and identified gaps in monitoring is presented in Appendix 2. The assessment is based on dividing the watershed into the upper, middle, and lower watershed as described in Section 3.

Monitoring priorities in each area should be determined according to the local landscape, pressures and needs. Sites are selected based on program applicability, property access permission, proximity to the road network and providing representation across the subwatersheds.

8.2 Partnerships and Funding

Funding for MVCA’s monitoring programs and initiatives comes from the following sources:

- MVCA general budget (municipal levy).
- Federal Government – Canada Summer Jobs grant to cover summer student wages (not guaranteed, variable from year to year).
- Ontario Federation of Anglers and Hunters (OFAH) – funds hiring of summer student through Invasive Species Hit Squad program.

- Other special grants and funding opportunities are also periodically sought to support specific projects (ex. updated mapping products such as DRAPE air photography and more recently LiDAR).

Several monitoring programs are carried out by MVCA with financial, technical and other in-kind support from partner agencies such as the Province of Ontario (PWQMN, PGMN) and the City of Ottawa (CBLWQ). MVCA has also had collaborative relationships with universities, many lake associations, and a variety of stewardship organizations. These collaborations become increasingly important as Provincial resources and services continue to diminish at the local level.

Enhanced partnering opportunities to be explored include the following:

- **Conservation Authorities:**
 - Review management of volunteer programs
 - Review approach to determining lake carrying capacity thresholds
 - Review data management and reporting tools
- **Municipalities:**
 - Identify preferred methods of obtaining baseline data for plan reviews
 - Provide regular reporting of findings for each municipality
 - Identify particular issues of concern for potential targeted study
- **Environmental Organizations and Citizen Science Programs:**
 - Continue to promote and facilitate participation in 3rd party programs
 - Enhance feedback loops to volunteers
- **Academia:**
 - Identify information gaps and approach local universities regarding specific study needs and partnering opportunities, such as:
 - Lakes at greatest risk due to climate change
 - Invasive species presence and management
 - Algae risks and management

9.0 Program Recommendations

9.1 Monitoring Activities

MVCA will continue to place priority and focus on surface water quality monitoring through the implementation of existing program based on their value in providing robust long-term data that supports municipal planning work support of related studies and other research. Groundwater monitoring will be limited to participation in provincially managed program in support of MVCA's Source Protection responsibilities.

Category 1

- **Provincial Water Quality Monitoring Network – PWQMN**
- **Provincial Groundwater Monitoring Network - PGMN**

Category 2

- **Stream and Lake Monitoring Program³³**, recognizing its primary value in identifying general trends over time and supporting municipal planning, consultant studies, and public education and outreach. It would be beneficial to assess data usage and undertake another review of the number and frequency of lakes being sampled.
- **Stream Watch Program³⁴** recognizing its value in providing detailed stream condition data in areas experiencing growth and urban pressures in support of municipal planning, consultant studies, public education and outreach, and design of MVCA stewardship programs.

Category 3

The following are monitoring activities are carried out on an opportunistic basis, have negligible incremental costs, and provide enhanced information regarding changes occurring in the watershed, and support the interests and work of lake associations.

- Continue **Stream Temperature** and **Lake Temperature Monitoring** programs as easy and cost-effective means of providing data that is relevant to assessing climate change impacts.
- Continue to implement the **Invasive Species Hit Squad** subject to funding from OFAH.
- Continue **Algae Monitoring** on an opportunistic basis in partnership with lake associations.
- **Seine Netting** Program is considered low priority and will only continue when resources

³³ This includes the existing City Baseline Monitoring Program, which is already subject to an MOU.

³⁴ This program is branded as the City Stream Watch program but occurs both within and outside of the City.

permit.

9.2 Monitoring Approach and Tools

The following actions are recommended to enhance the quality of the program:

- Review monitoring requirements set out in the **Mississippi River Water Management Plan** with provincial agencies and confirm scope of monitoring to be carried out by MVCA.
- Undertake a program priority assessment of the **Ontario Stream Assessment Protocol - OSAP** to review data use, resources requirements (staff time, incidental costs, etc.) and overall benefits. Implement as resources permit with possible refocusing towards urban, urban fringe and agricultural areas.
- Undertake a program priority assessment of the **Headwater Drainage Feature Protocol**. Implement as resources permit with a limited number of sites surveyed per year in line with the City Stream Watch rotation.
- Actively pursue partnerships and external funding opportunities to support frequent updates to mapping/GIS products to enable assessment of forest and wetland cover.
- Continue to use the three standardized reporting formats listed in Table 2 to provide the public and other agencies with easily comparable data.
- Continue to standardize data storage formats and ensure a minimum of two full time employees within the Planning Department are fully trained in the use of WISKI.
- Budget for a part-time Monitoring Technician to support work on monitoring protocols and provide assistance during peak periods. Work and objectives as outlined in this document require seasonal support from additional staff resources.

9.3 Potential New Initiatives

The following have been identified, primarily through the Mississippi River Watershed Plan, as potential further actions and/or initiatives:

- Reassess monitoring program allocations based on local indicators and pressures (development and results). Considerations to include:
 - Viability of additional water quality monitoring focused in agricultural areas and urban/urbanizing areas outside of the City of Ottawa (Carleton Place, Mississippi Mills and surrounding areas).
 - Potential expansion of City Stream Watch and/or refocusing of OSAP into urban and agricultural areas that aren't currently being monitored.
- Assess groundwater data needs and identify solutions to augment data as needed to support MVCA responsibilities in Source Protection (Cat 1). This may include tracking and warehousing

of data already collected through other means, such as monitoring wells for development proposals, or through periodic sampling of private wells in strategic locations.

- Seek additional external funding/grants and partnership arrangements to support existing and new monitoring initiatives.
- Work with MVCA Water Management Department to increase the analysis/use, sharing and reporting of the data collected through the following:
 - Tracking of data requests (who is using the data and for what purpose).
 - Consider use of Open Data
- Increase emphasis on volunteer-based citizen science activities and programs, to heighten community interest and broaden the collection of baseline information.

Appendix 1: Data Needs versus Availability (primary and supplemental sources)

Primary vs. Secondary	MVCA					Province						Feds	Municipal health units	NGOs incl. lake associations				
	Lake	Stream Watch	Fish	Benthics	Water Temperature	PWQMN	PGMN	Fish (BsM, SLIN, Creel)	Managed Forests	Habitat Classification	Lake Capacity (nutrient model)			Site Specific	Drinking water (surface intakes, wells, beach safety)	Ontario Anglers and Hunters	Ducks Unlimited	Watersheds Canada
1. Water Quality											P	Enviro. Canada standards	P				X	X
a. Drinking Water						S	S						P				X	
b. Nutrients	P					P	P				X						X	
c. Aquatic life	P		P	P	P			P				DFO					X	X
2. Habitat	P	P	P	P	P							DFO			P	P	X	
a. Shorelines		P								X					S	P	X	
b. Tributaries		P	P	P	P													X
c. Lakes					P			P		X		DFO					X	X
d. Forests									P	X								
e. Wetlands		M				M				P					P			
3. Species		P	P	P	P			P	P	P		DFO/Enviro Can			P			

Primary vs. Secondary	MVCA					Province						Feds	Municipal health units	NGOs incl. lake associations				
	Lake	Stream Watch	Fish	Benthics	Water Temperature	PWQMN	PGMN	Fish (BsM, SLIN, Creel)	Managed Forests	Habitat Classification	Lake Capacity (nutrient model)			Site Specific	Drinking water (surface intakes, wells, beach safety)	Ontario Anglers and Hunters	Ducks Unlimited	Watersheds Canada
a. Species at Risk									P			X						
b. Invasive species	S	S						S	S			X		P			X	
4. Lake Capacity										P							X	

Appendix 2: Monitoring Program Details

Program	Program Partners	Data Collected	No. of Sites, Frequency & Months Sampled
Provincial Water Quality Monitoring Network (PWQMN)	MECP	Water Chemistry	14 sites 8 times/year Spring – fall
City Baseline Water Quality (CBLWQ)	City of Ottawa	Water Chemistry	17 sites 8 times/year Spring – fall
MVCA WQ	None	Water Chemistry	2 sites 8 times/year Spring – fall
Ontario Stream Assessment Protocol (OSAP)	MNR, FWIS	Fish, aquatic vegetation, surrounding land use	25 – 30 sites per year May, July, August
City Stream Watch	RVCA, SNCA	Land use, riparian & bank conditions, fish/wildlife, pollution, max. water temp.	2 - 3 streams per year Summer
Headwaters	RVCA	Morphology and flow	15 to 20 sites per year Early spring, August
Stream Temperature Monitoring	MNR, FWIS	Water temp.	20 sites, 15 mins intervals May, July, August
Lake Monitoring	Lake Stewards (volunteers)	Phosphorus, pH, Dissolved Oxygen, Temp Profiles	44 lakes/62 sites 2-8 yr. cycle 10 to 12 sites 3 times/yr. Spring, Summer, Fall
Seine Netting	Lake Stewards	Near shore fish population	3-5 sites 1 day/year Summer
Lake Water Temperature	None	Near surface water temp.	6 sites, 15 min intervals Spring – fall
Algae Monitoring	None	Incidental observations about occurrences	Throughout watershed Continuous Ice off period
Provincial Groundwater Monitoring Network (PGMN)	MECP	Water level, water chemistry	9 sites - well checks 2-3/year, chemistry 1/year Spring – fall
Invasive Species Hit Squad	OFAH	Incidental observation occurrences Community education events.	Throughout watershed. Stream and lake focused. Continuous Ice off period

Appendix 3: Geographic Assessment of Program Delivery

	Key Pressures Identified	Current Priorities	Gaps and Additional Needs
Upper Watershed	<ul style="list-style-type: none"> • Lake/waterfront development • Invasive aquatic species 	<ul style="list-style-type: none"> • Monitoring of large highly developed lakes, cold water lakes, and lakes representative of each of the main rivers (water quality and invasive species) • Stream sites – cool and cold water 	<ul style="list-style-type: none"> • None identified
Middle Watershed	<ul style="list-style-type: none"> • Lake/waterfront development • Rural development (mostly lot creation) – impacts to natural systems (wetlands and forested areas). • Some agricultural activity, mostly in south and east 		<ul style="list-style-type: none"> • Lack of monitoring in agricultural areas for surface water quality impacts • Lack of monitoring of rural development impacts to natural heritage systems (wetlands, forested areas)
Lower Watershed	<ul style="list-style-type: none"> • Urban and urban expansion area development • Mississippi Lake development • Waterfront properties along rivers • Agricultural activity • Development impacts to natural systems (wetlands and forested areas). 	<ul style="list-style-type: none"> • Stream sites within or adjacent to urban boundary • Mississippi Lake water quality and invasive species monitoring 	<ul style="list-style-type: none"> • Lack of groundwater data to support and assess potential impacts of rural development

This table presents a general overview and geographic assessment of the pressures, monitoring priorities and identified gaps in monitoring based on the three areas shown in Figure 2. The **Upper Watershed** represents the Canadian Shield area, the **Middle Watershed**, is the transition area between the Canadian Shield and St. Lawrence Lowlands and the **Lower Watershed** is the Lowlands area.