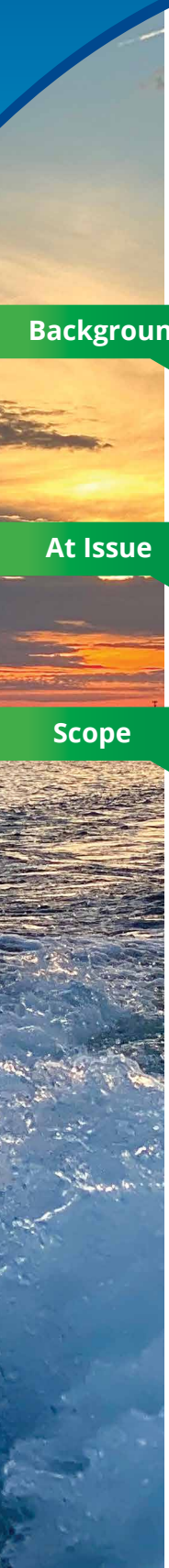
Watershed Water Quality Indicators Program Design and IWM Implementation

THE DISTRICT MUNICIPALITY OF MUSKOKA



This project is part of the extended **Integrated Watershed Management (IWM)** initiative, focusing on reducing flooding impacts and enhancing Muskoka River Watershed (MRW) health. It's one of seven chosen for expansion from the original twelve projects. This initiative supports and advances the implementation for an IWM approach for the entire MRW.

You can find more information on the Phase One Report and the accompanying Summary Factsheet on the District of Muskoka Website at: www.muskoka.on.ca/iwmprojects

Background

The Water Quality Indicators Project initially offered guidance for Integrated Watershed Management in the Muskoka River Watershed. This extension project was launched to provide guidance for citizen-led organizations, aiding the development of monitoring programs addressing emerging water quality concerns and traditional stressors affecting the lakes. The goal is to comprehend changes, assess lake health, and enable effective management strategies.

At Issue

Lakes in the Muskoka River Watershed are facing stress from a mix of emerging issues in water quality, coupled with impacts from traditional stressors like waterfront development. These combined factors, including effects of climate change, are causing significant changes in both living and non-living aspects of the lakes. This underscores the critical necessity for detailed water quality monitoring programs to understand these changes, track lake health, and inform effective management strategies promptly.

Scope

This report was completed to provide comprehensive background information aiding the development of citizen science-led monitoring programs, covering:

- ✓ Overview of current and emerging threats to water quality
- ✓ Plain-language explanation of each water quality parameter's importance
- ✓ Recommendations for best practices and methods to monitor lake health, including a layered approach to program development.
- ✓ Brief overview of technology options for continuous monitoring of water quality and lake health
- ✓ Suggestions for data management and analysis.
- ✓ Incorporating emerging contaminants

Emerging Issues in Water Quality

- Changing climate effects on lake ecosystems
- Proliferation of harmful algal blooms
- Impact of invasive species
- Declining calcium in lakes
- Presence of emerging contaminants such as pharmaceuticals, personal-care-product additives, pesticides, engineered nanomaterials, and microplastics
- Contributing factors like faulty septic systems, road salt, and climate change, as major sources of impact on lakes in the Muskoka River Watershed

Water Quality Parameters

Phosphorus	Vital nutrient that, when excessive, triggers algae growth, diminishing water clarity and harming aquatic life. Monitoring phosphorus levels is crucial to maintain a healthy lake environment.
Water Clarity	Reflects how clear the water is. It helps understand overall water quality, with lower clarity often indicating potential issues impacting the lake's health.
Bacteria Levels	Indicators of water safety, especially for recreational activities like swimming. Monitoring bacteria helps ensure water is safe for people and aquatic life.
Water Temperature	Influences the amount of oxygen and where nutrients are in the lake. Changes in temperature due to climate shifts can affect the types of life in the lake.
Dissolved Oxygen (DO)	Essential for fish and other aquatic creatures to survive. Fluctuations in dissolved oxygen levels impact the health of the lake's ecosystem.
Calcium and Chloride	Important for tracking potential road-related impacts on freshwater life. Decreasing calcium harms certain species, while elevated chloride levels can be toxic to aquatic organisms.
Nitrogen (N)	Crucial for lake health, but excess nitrogen can lead to harmful algae growth. Monitoring helps maintain the balance for a healthy ecosystem.
Dissolved Phosphorus	Helps understand how nutrients move within the lake, which is important for assessing overall nutrient availability and ecosystem health.
Electrical Conductivity	Indicates water's hardness and the levels of ions present. It helps trace specific ions, identifying their sources and potential impacts.
Dissolved Organic Carbon	Affects nutrient interactions and aquatic life. High levels may impact plant growth but can also protect aquatic organisms from harmful sunlight.
Alkalinity & pH	Show how resistant water is to changes in acidity. Extreme pH levels can negatively impact the diversity of aquatic life, so monitoring is essential.
Turbidity	Measures suspended particles, which impacts water quality. Higher turbidity often indicates lower-quality water.
Metals	Have varied roles; some can harm aquatic life, while others are essential nutrients. Monitoring metals helps understand their impact on water health.
Phytoplankton	Essential for a healthy ecosystem, but excessive growth can lead to harmful algal blooms, affecting water quality and safety.
Emerging Contaminants	Synthetic substances that could be concerning. Monitoring them helps track potential environmental risks in lakes.

Best Practices for Monitoring

Sampling Frequency

- Lake monitoring usually occurs annually, but specific sample collection frequency depends on resources, lake type, and goals.
- Biweekly or monthly sampling is ideal for assessing seasonal changes in water quality, but it might not be feasible for all programs.

Number of Sampling Locations

- The number and location of sampling sites depend on lake size, depth, and shape.
- Multiple sites are beneficial for large, diverse lakes due to varying water quality across different areas.

Selection of Parameters

- Core parameters include water clarity, nutrient levels, temperature, oxygen, ions, pH, and chlorophyll.
- Additional assessments may involve biological communities, bacteria, and monitoring for specific contaminants.

Basic Monitoring - Lake Partner Program

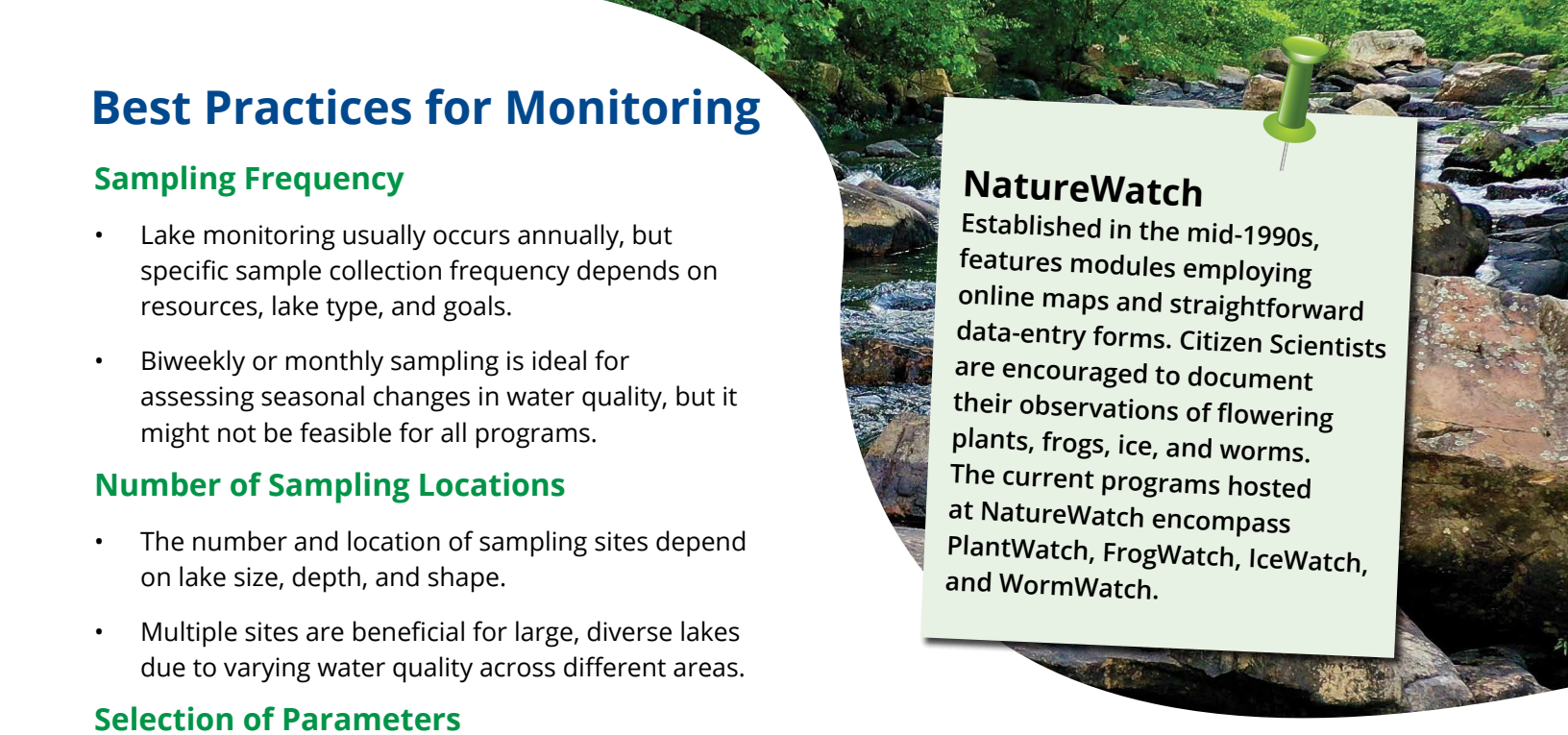
- The Lake Partner Program (LPP) aids lake associations with limited resources by providing sampling instructions and equipment.
- It focuses on key water quality issues, utilizes citizen volunteers, and maintains a central database of collected data.

Expanded Independent Monitoring

- Lake associations can expand beyond the LPP with guidance from experts, additional equipment, and standardized data recording.
- Detailed instructions cover sampling, analysis, metadata, and considerations for specific parameters and biological communities.

Biological Communities

- Different monitoring methods and costs exist for assessing phytoplankton, zooplankton, benthos, and macrophytes.
- Citizen participation in NatureWatch programs contributes to understanding ecological changes and engages the public in environmental monitoring.



NatureWatch

Established in the mid-1990s, features modules employing online maps and straightforward data-entry forms. Citizen Scientists are encouraged to document their observations of flowering plants, frogs, ice, and worms. The current programs hosted at NatureWatch encompass PlantWatch, FrogWatch, IceWatch, and WormWatch.

Technology Options for Monitoring

Local Meteorology Monitoring

Utilize user-friendly meteorology stations for hyper-local weather data.

Water Temperature/Stratification

Use temperature loggers for depth-specific temperature monitoring.

Lake Water Quality Monitoring

Employ water quality loggers or multi-parameter sondes for continuous monitoring.

Phytoplankton Assessment

Use FluoroProbe or Turner Designs sensors to quantify phytoplankton biomass.

Shoreline Characteristics Evaluation

Conduct visual surveys or utilize drone imagery for shoreline analysis.

Tributary Inputs Monitoring

Employ continuous monitoring using sondes and loggers, including autosamplers during high-flow events.

Data Management and Analysis

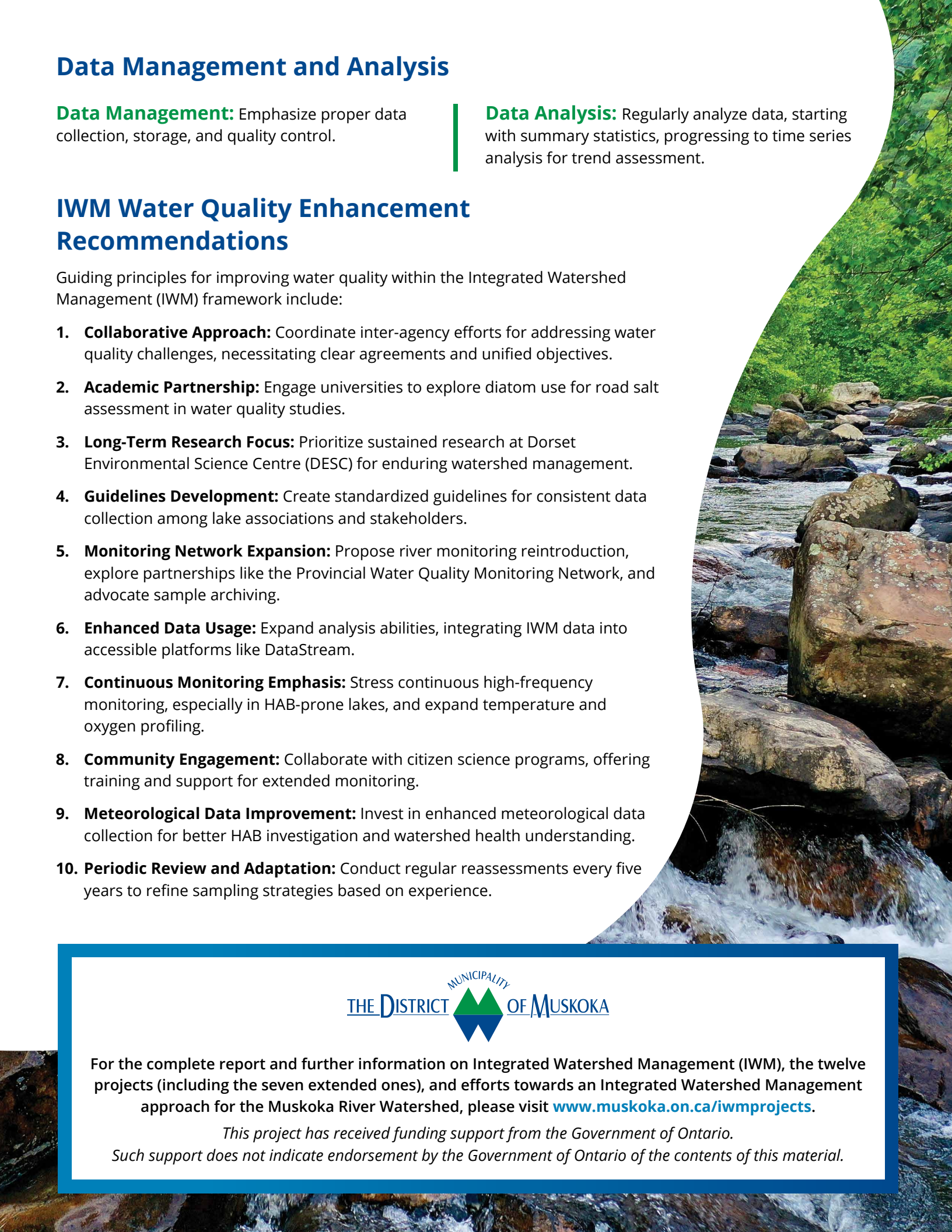
Data Management: Emphasize proper data collection, storage, and quality control.

Data Analysis: Regularly analyze data, starting with summary statistics, progressing to time series analysis for trend assessment.

IWM Water Quality Enhancement Recommendations

Guiding principles for improving water quality within the Integrated Watershed Management (IWM) framework include:

1. **Collaborative Approach:** Coordinate inter-agency efforts for addressing water quality challenges, necessitating clear agreements and unified objectives.
2. **Academic Partnership:** Engage universities to explore diatom use for road salt assessment in water quality studies.
3. **Long-Term Research Focus:** Prioritize sustained research at Dorset Environmental Science Centre (DESC) for enduring watershed management.
4. **Guidelines Development:** Create standardized guidelines for consistent data collection among lake associations and stakeholders.
5. **Monitoring Network Expansion:** Propose river monitoring reintroduction, explore partnerships like the Provincial Water Quality Monitoring Network, and advocate sample archiving.
6. **Enhanced Data Usage:** Expand analysis abilities, integrating IWM data into accessible platforms like DataStream.
7. **Continuous Monitoring Emphasis:** Stress continuous high-frequency monitoring, especially in HAB-prone lakes, and expand temperature and oxygen profiling.
8. **Community Engagement:** Collaborate with citizen science programs, offering training and support for extended monitoring.
9. **Meteorological Data Improvement:** Invest in enhanced meteorological data collection for better HAB investigation and watershed health understanding.
10. **Periodic Review and Adaptation:** Conduct regular reassessments every five years to refine sampling strategies based on experience.



THE DISTRICT MUNICIPALITY OF MUSKOKA

For the complete report and further information on Integrated Watershed Management (IWM), the twelve projects (including the seven extended ones), and efforts towards an Integrated Watershed Management approach for the Muskoka River Watershed, please visit www.muskoka.on.ca/iwmprojects.

This project has received funding support from the Government of Ontario.
Such support does not indicate endorsement by the Government of Ontario of the contents of this material.