Integrated Watershed Management:

Navigating Ontario's Future

Summary Report

Conservation Ontario

Ontario

ACKNOWLEDGEMENTS

Integral to the development of these reports were a number of individuals from various organizations who provided data, attended meetings, reviewed draft documents and provided input to the project. Significant contributions from Environmental Water Resources Group are acknowledged with regard to the Water Management Framework Report. In addition, full acknowledgement is noted with respect to the work completed by Blackport and Associates for their work on the Water Budget Synthesis Report. The facilitation of workshops and follow up summary reports provided by Kidd Consulting is also acknowledged. The work of Hazel Breton (P.Eng) on the Integrated Watershed Management Reports and overall project management of this initiative is also acknowledged.

Conservation Ontario
Box 11, 120 Bayview Parkway
Newmarket, Ontario L3Y 4W3
(Office) 905-895-0716
(Fax) 905-895-0751
www.conservationontario.ca

2010

TABLE of CONTENTS

INTEGRATED WATERSHED MANAGEMENT
Navigating Ontario's Future

Summary Report

1.0 | Introduction

This summary document is part of a shared undertaking between Conservation Ontario (representing Ontario's 36 Conservation Authorities), the Ontario Ministries of Natural Resources and Environment and the Department of Fisheries and Oceans Canada to explore jointly our understanding of IWM in Ontario, assess it against other IWM work occurring globally and nationally to identify gaps, and recommend strategic shifts needed to address the identified gaps in working towards a Provincial Integrated Watershed Management Framework. This work is intended to update our understanding of Integrated Watershed Management (IWM) in Ontario.

As part of this initiative, a series of three reports were developed:

- Integrated Watershed Management in Ontario

  Phase I: Status of Integrated Watershed Management

  Phase II: Defining Integrated Watershed Management in Ontario

  Phase III: Updating Integrated Watershed Management in Ontario

- A Water Management Framework for Ontario

- A Water Budget Overview for Ontario

This document includes the Executive Summaries from all three reports, combined.

Water is needed in all aspects of our life and in order to ensure ongoing sustainability of this important resource, a more integrated approach needs to be adopted using the watershed as a managing unit.

For the purposes of these reports, Integrated Watershed Management is defined as: managing human activities and natural resources in an area defined by watershed boundaries aiming to protect and manage natural resources and their functions today and into the future.

The reports begin by updating our understanding of Integrated Watershed Management (IWM) in Ontario, assessing it against IWM being conducted globally and nationally, identifying gaps, and recommending strategic shifts needed to address these gaps. From this research, we are able to categorize a set of tools that could be applied to Ontario for planning and decision-making.

The myth of water abundance in Ontario is a key challenge and must be overcome to fully protect our resources. Agencies need to work together to protect our watersheds for the well being of all Ontarians. There is a need to develop a shared vision by all stakeholders in order to effectively manage impacts from our changing climate, population growth, increased urbanization and aging infrastructure. In the future, water frameworks will need to address risk-based approaches and aspects of adaptive environmental management And, there is some urgency to addressing these challenges as reversing negative impacts becomes more difficult and expensive with time.

In addition to looking at IWM in Ontario, these reports also explore the development of a Water Management Framework and Water Budget Overview for Ontario. The IWM approach identifies water management and ecosystem issues that must be evaluated to determine their relative importance and to decide which issues will be addressed. Under the umbrella of IWM, the water management framework is intended as a practical guide that assists agencies with a mandate for water management to work together to fulfill their collective mandates to ensure a sustainable water resource for the Province of Ontario. The water budget assessment would be one component (of many) within the water management framework. Given this hierarchical

Protecting natural resources and their functions.

relationship and the underlying principle of adaptive environmental management, many feedback loops exist between these approaches.

This report summarizes the research and information contained in all of the reports' executive summaries. Considerations for next steps are also addressed.

2.0 | Integrated Watershed Management in Ontario

PHASE I
Status of Integrated Watershed Management in Ontario

Canadian watershed managers (practitioners) face significant challenges in maintaining Canadian water quantity and quality today. Managing the expected hydrologic impacts of climate change and the resource-needs of a sustainable ecosystem must be balanced with managing intensified population growth and urbanization, changing uses of water, pollution from air and land and introductions of exotic & invasive species.

The initiative consists of three phases;

Phase I - Status of Integrated Watershed Management

- Assess the IWM approach from a global, national, great lakes basin and local watershed perspective;
- Condense the work carried out in Ontario to date in IWM;

Phase II - Defining Integrated Watershed Management in Ontario

- Identify the legislative requirements for IWM in Ontario;
- Identify connections to other initiatives ongoing in Ontario and Canada
- Identify key issues facing Ontario (e.g. climate change, infrastructure needs, sustainable practices)
- Identify the gaps in IWM in Ontario

Phase III - Updating IWM in Ontario

- Identify strategic shifts needed to address gaps
- Make recommendations for next steps

According to the Canadian Chamber of Commerce, the past several years have provided us with numerous examples of the need for a national water strategy. "The floods, droughts, Great Lakes pollution problems, the variability of our climates and the impact of our activities on that climate all speak to the need for a coordinated effort between the federal, provincial and municipal governments to develop national policies and practices for one of our most precious resources." [1]

Water is needed in all aspects of our lives and in order to ensure ongoing sustainability of this important resource and linkages, a more holistic – or integrated – approach needs to be adopted using the watershed as a managing unit. Integrated Watershed Management is managing human activities and natural resources in an area defined by watershed boundaries aiming to protect and manage all natural resources and their functions today and into the future.

This approach recognizes and operates based on the interconnectedness of ecology, economy and society. In this way, we are able to ensure that adequate supplies of good quality water are maintained for the entire population while preserving the hydrological, biological and chemical functions of ecosystems while adapting human activities within the capacity limits of nature. (United Nations)

Although it is widely understood that water should be holistically managed, it wasn't until the Dublin Conference on Water and the Environment in 1992 that the global community called for a more comprehensive approach to water management in order to achieve sustainable development.

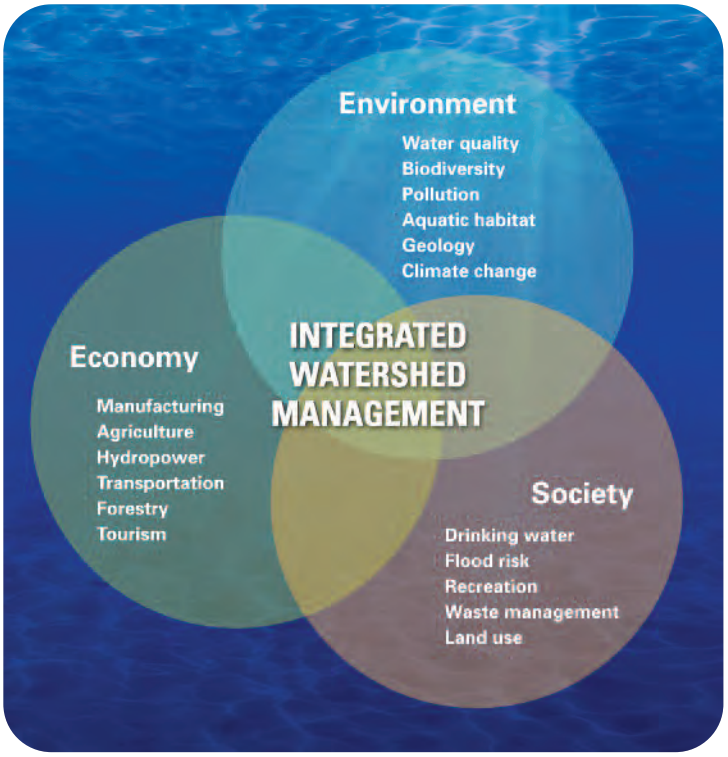
Globally

Reviewing how IWM has evolved around the world, in such key areas as Australia, Brazil and Europe, we find there are a number of major shifts that occurred over time among policy makers and water managers. This could lend some ideas to the shifts that may be needed in Canada, and specifically, in Ontario.

Global View

Global shifts from traditional policy perspectives included:

- **Sectoral to integrated management**
- **Top down to stakeholder and demand responsive change**
- **Supply fix to demand management**
- **Command and control to more cooperative or distributive forms of governance**
- **Closed, expert-driven management organizations to more open, transparent and communicative bodies**



1. Canadian Chamber of Commerce, Water for Sustainability: A Strategy, 2006

Nationally

From a national perspective, two processes currently being used by some departments of the Federal Government are examined. These include Regional Environmental Assessment (REA) and Large Ocean Management Area (LOMA). While there is no single approach to REA and a range of approaches exist, the process is often thought to be designed to facilitate multiple project-based assessments within a common geographic region. LOMAs have been established to advance collaborative management amongst all levels of government to develop strategic and long-term plans so that ecosystem health and economic development issues can be suitably managed.

There are a number of important contributions from non-government organizations which deserve review and recognition for the contribution they make to the process of IWM in Canada. Key conclusions made by organizations such as the Canadian Water Resources Association, Polis and Pollution Probe call for changes to enhance the abilities of ecosystem managers to manage water and the ecosystem ensuring critical connections to social and economic considerations.

Many of the non-government organizations see IWM as a fundamental tool in addressing principles on sustainability and ecosystem-based management. Calls for federal and provincial water policies and strategies were consistently raised along with the need for improved inter-agency coordination with clear governance structures. The concept of shared responsibility was also raised in engaging and connecting with the watershed community. Stable funding for expertise, planning and implementation for water management, precautionary principle and pollution prevention were seen as underpinning principles. Economic instruments such as polluter pay and recognizing the economic value of water were raised as a source of management costs.

Great Lakes

International and domestic agreements pertaining to protection and restoration of the Great Lakes Basin ecosystem support watershed management. Much of the work of the International Joint Commission consists of assisting the Governments of Canada and the United States to achieve their goal of cleaning up the Great Lakes and preventing further pollution in the system. In recommending changes to the Great Lakes Water Quality Agreement, the International Joint Commission's fourth recommendation reads as:

The Commission recommends that the Agreement specify that watersheds be the geographic units to coordinate, integrate and implement programs called for by the Agreement and set out in the Binational Action Plan.

As per the Canadian Department of Foreign Affairs & International Trade, News Release dated June 13th, 2009:

"...the Great Lakes are still at risk from current and emerging challenges such as increased population and urbanization, land use practices, invasive species, new chemicals and the impacts of climate change. Negotiations over the coming months will aim to strengthen and modernize the Agreement to better address these perils."

Provincially

We are able to look at a number of current approaches espousing the concepts of IWM and ecosystem based planning in the provinces of British Columbia, Alberta, Manitoba and Quebec. The effectiveness of new and existing watershed planning initiatives, policies and practices, including the provincial approaches from Quebec and Alberta offer improved opportunities for inclusiveness and shared responsibility.

Work to date in Ontario, stems primarily from three sets of watershed planning documents released as guidance tools in 1992. Since that time, many watershed and subwatershed studies have been carried out as well as some interim work evaluating IWM in 1997. In 2004, the lessons learned from the work completed to date in Ontario were published by Conservation Ontario in a study entitled Watershed Management in Ontario: Lessons Learned and Best Practices. This report evaluates case studies from three of the 36 Conservation Authorities in Ontario.

Ontario is a world leader in the area of integration of different scientific disciplines as a result of the work done by the Ontario government and local Conservation Authorities. Working alongside their municipal counterparts, Conservation Authorities implement local solutions in response to a variety of issues.

Tools for Planning and Decision-Making

From this research, we are able to categorize a set of tools that are needed in Ontario for planning and decision-making. Such tools can be categorized into the following components (Global Water Partnership):

- **Management Instruments**
- **Enabling Environment**
- **Institutional Framework**

Management Instruments include tools such as Integrated Watershed Management plans that characterize watersheds, predict impacts from various scenarios and develop implementation plans for a watershed that will achieve outcomes such as sustainable growth etc. An Enabling Environment includes developing tools such as policies, a legislative framework and financial structures. Institutional Frameworks include developing governance models that outline how agencies will work together to make decisions by developing solutions and implementing results.

The success of the Flood Damage Reduction Program and the Source Water Protection programs in Ontario are good examples of how these tools were applied and continued to be applied with considerable success.

Integrated watershed management promotes sustainability, integrated management, transparent decision-making and engagement of a variety of stakeholders. Identifying the gaps in our approach to Ontario's IWM concept will help us to determine the shifts that need to be made in order to ensure the health of our watersheds and the people who live within them.

PHASE II
Defining Integrated Watershed Management in Ontario

Ontario's watershed managers strive to minimize harmful impacts and influences on water and related natural resources in order to ensure the environmental, social and economic well being of Ontario on a sustainable basis. Watershed management is a tool to aid water and land use decision makers. [2]

Evolution of IWM in Ontario

Our knowledge and perspectives around the connectivity between water and related land resources has shifted considerably from the 1960s to the present. In the 1960s and 1970s, the issues around water were focused primarily on quantity and related mainly to flooding of property and erosion of streams. The 1980s saw the beginnings of attempts to manage stormwater runoff and improvements to the design of new and existing infrastructure such as culverts. With the increase in development in the mid-to late 1980s, we needed to also focus our attention on erosion and sediment control emanating from construction sites.

Later in the 1980s, aquatic habitat came under scrutiny because of the impact stream conditions were having on fish habitat and fish populations. At the same time water quality concerns arose as connections became evident between stormwater runoff and increased pollution in streams.

Throughout the 1990s, the list of concerns grew to include aquatic habitat, water temperatures, baseflow, riparian systems and natural infrastructure (wetlands, woodlots, wildlife, etc.). As watershed management plans began to develop in the 1990s we became more aware of the need to integrate the different fields of study along with economic and social science components. As these plans progressed, we incorporated scenario testing, information management and clear implementation strategies to the process.

Throughout the 2000's, we have been grappling with the impacts of climate change, the need for social marketing, green infrastructure and more sustainable tools for watershed assessments. Considerations around IWM today are now concerned with the urgent need to establish more effective collaborations to promote better governance in order to share responsibilities and ensure sustainable outcomes.

Key Issues and Challenges Facing Ontario

Consultations in the form of surveys, workshops and research revealed that most issues and challenges are related to concerns over improved management of Ontario's natural resources. The myth of water abundance in Ontario held by the public is a key challenge and must be overcome to fully protect our water resources. Another challenge was the need for agencies to work more closely, sharing knowledge, information and decision-making in order to protect our watersheds and the well-being of Ontarians. Developing a shared vision by all stakeholders through a watershed-based approach to manage impacts from our changing climate, population growth, and aging infrastructure was also seen as a key issue. Not having policies and associated practices using a risk-based approach that support adaptive environmental management and the precautionary principles to foster creativity and innovation for improved environmental protection was seen as a key challenge that must be overcome. There is some urgency to addressing these challenges as reversing negative impacts becomes more difficult and expensive with time.

Over the longer term, there is a need to build social capital with ongoing education for those in a decision-making role and those who live, work and recreate in our watersheds so that the above challenges can be fully addressed through appropriate change.

2. Evaluation of the Watershed Management Initiative, Watershed Planning Implementation Project Management Committee, January 1996.

Integrated Watershed Management as a Decision-Making Process

Integrated watershed management is the process of managing human activities and natural resources in an area defined by watershed boundaries. It is an evolving and continuous process through which decisions are made for the sustainable use, development, restoration and protection of ecosystem features, functions and linkages. IWM allows us to address multiple issues and objectives; and enables us to plan within a very complex and uncertain environment.

One of the keys of successful IWM is the integration of scientific components with multiple stakeholder and agency responsibilities, requiring us all to understand exactly what is going on in our local watersheds in the big picture and what has to be done to ensure a sustainable future. IWM can be applied at different scales, however, implementation always take place at a local level – in other words, in our own backyards.

IWM has evolved over the years – both on global scale and here in Ontario. As part of the process of developing IWM plans we need to consider the impacts of a variety of watershed stressors such as climate change and growth pressures. This ultimately leads to better management decisions that help to set priorities, pool limited resources and increase efficiency among governments. IWM links human behaviour and environmental impact and by planning within this context, we can ensure healthy, safe environments that provide a good quality of life.

The underlying principle behind the IWM process is **Adaptive Environmental Management** which is the continuous and cyclical process of carrying out a plan that addresses identified issues and concerns that is then implemented, monitored, reported on and updated as required in order to adapt to changing or new emerging stressors.

Status of IWM in Ontario

In Ontario, practitioners integrate different science disciplines. Traditionally, water policies or programs have been 'feature' or activity-specific. As well, interpretation of policies referring to IWM varies across Ontario. Generally, water and associated environmental resources governance is shared by many agencies across different geographic scales in the province.

For the purposes of this report, two surveys were conducted in 2008 and 2009 assessing the understanding and involvement in IWM by Ontario's 36 Conservation Authorities and a variety of government agencies. This report provides the results of these surveys.

Survey information indicated that IWM is practiced by Conservation Authorities. Legislated under the *Conservation Authorities Act* since 1946, these agencies have been using watershed plans since this time. The particular approach they use today dates to the 1990s. However, implementation of Watershed Plans across Ontario is varied and there is an actual decline in the number of plans and associated implementation actions due to a lack of funding.

Survey input indicated that water and associated environmental resources are generally shared by many agencies across different geographic scales in the province. However, there is a lack of collaboration on IWM amongst stakeholders, therefore the role and contribution of IWM is not fully realized in Ontario.

Barriers to IWM in Ontario

One of the first barriers we run across is the actual attitudes of the general public around water. A recent survey conducted in 2008 by RBC and Unilever Canada found that there is a long way to go to raise the profile of water as a top environmental concern for Canadians.[3] Three quarters of those surveyed said that they were confident that Canada has enough freshwater supply for the long term. Although this number has declined marginally from previous surveys, this is still a large majority of Canadians buying into the myth that we have an abundant supply of freshwater. Compared to other parts of the world, Canada does have a larger supply of freshwater but – like everywhere else, it is being seriously impacted by climate change, increased urbanization, as well as multiple and changing water uses.

A number of barriers were identified from a Conservation Authority perspective:

- **Insufficient staff and resources** hamper the ability of these agencies to produce watershed plans;
- **Ever-emerging provincial legislation** centered around single issues have the potential to create planning & implementation duplication and conflicting objectives. Examples include Oak Ridges Moraine Act, Greenbelt Plan, Growth Plan and Lake Simcoe Act;
- **Data gaps** – there is a lack of data or access to data required to develop comprehensive watershed plans;
- **Social and Economic Science linkages** specific to Ontario are lacking. This area provides a real opportunity for Ontario be a national leader;
- **Funding limitations** often reflect the lack of public and political understanding and support;
- **Sustainable public and political support** for work whose outcomes are long term.

As a result of these barriers, Conservation Authority watershed planning and implementation has actually declined in Ontario today.

Barriers identified in the survey completed by government agencies centered on their lack of knowledge and decision-sharing, inadequate funding, no common vision for using an integrated approach, no champions and no definition of or available best practices for the IWM concept.

While there are many barriers that agencies strive to work around today, watershed and subwatershed studies and plans also provide important opportunities for Conservation Authorities to build their scientific knowledge of local watersheds and to share this knowledge with residents, landowners, and other agencies such as through watershed report cards.

The implementation that follows a watershed plan is viewed by Conservation Authorities as an opportunity for them to build and/or strengthen local partnerships through plan development and implementation, gaining mutual trust and influence key areas such as budgets and land use change. Involving local stakeholders greatly helps to streamline and set watershed priorities and to obtain implementation funding. Their participation is critical.

Compared to other parts of the world, Canada does have a larger supply of freshwater, but - like everywhere else, it is being seriously impacted by climate change, increased urbanization as well as multiple and changing water uses.

3. RBC and Unilever Canada, Canadian Water Attitude Survey 2009

Gaps in IWM in Ontario Today

Science, Computer Modelling & Mapping

Gaps around current IWM practices generally identified by Conservation Authorities focused around science, computer modelling and mapping. Specifically these agencies identified gaps around surface water and groundwater interaction; the role of groundwater across all disciplines; water quality protocols, data management & dissemination; and the inability to accurately predict fish populations based on habitat and their relationship with biodiversity. As well more GIS and analysis data is needed particularly around interactions between different types of land uses and corridors/habitats. Conservation Authorities would also like to see improvements in the regional data and analysis available for stream structure and functions in order to better predict changes and drivers. There have been significant improvements made around mapping and data management, particularly in the ability of digital data to be overlaid to more accurately illustrate overall integration in Ontario watersheds. However, the availability of base mapping in digital form is limited.

Another important gap identified by Conservation Authorities is the lack of Canadian-specific information and data around economic - environmental linkages – specifically, we are short of templates, frameworks and models – tools that would help to link our natural environmental with economic models to further illustrate their connectivity and associated values.

A similar gap exists between the social sciences and our world of environmental science. We need a better understanding of the science of people - of public attitudes, values and knowledge - in order to begin to influence their ecological awareness and behaviour.

Process

The process followed in typical watershed and subwatershed studies has evolved over the years. Conservation Authorities currently rely on a number of typical components: scoping, characterization, plan development, management alternatives and implementation. However, there are also clear gaps in the process having to do with developing targets, monitoring and evaluating implementation, and updating plans.

Program

The research carried out in Phase I identified the broad shifts that were occurring nationally in water management as follows (Pollution Probe):

- from process to outcomes;
- from water management to watershed management
- from regulating to shared responsibility; and
- from government to governance [4]

It was determined that Ontario's IWM concept should be evaluated using a set of tools with a view to updating and formally recognizing its role in Ontario to include Management Instruments, Enabling Environment and Institutional Framework.

We need to take a look at governance. In this context, governance can be defined as "an effort to build, manage and maintain inter-organizational networks". In other words, we need to develop an *institutional ecosystem*. The challenges facing us are to develop coordination and decision-making frameworks that are resilient and allow for adaptation.

4. *A New Approach to Water Management in Canada* Pollution Probe (March 2008)

PHASE III
Updating Integrated Watershed Management in Ontario

Strategic shifts are needed to address gaps and update our approach to integrated watershed management for Ontario today.

Integrated watershed management is a process based on the concept of Adaptive Environmental Management. This approach aims to improve the understanding of the ecosystems being managed and the institutions charged with their management.

Integrated watershed management should not be seen as another layer in addition to that which already exists in Ontario. IWM is being done in Ontario by Conservation Authorities and serves to assess watershed functions and the potential impacts from change in order to ensure sustainability. The watershed unit provides context so that we can understand how impacts are felt and how they can accumulate.

Shifts in IWM Scientific Assessment

Phase II Summary Report identified a number of barriers and gaps from the Conservation Authority perspective. A brief summary of these includes:

- lack of scientific data, models, protocols and analyses
- Insufficient resources (time, funding, expertise) for planning & implementation (setting targets, monitoring & evaluation implementation, updating plans)
- Lack of up to date mapping;
- Ever-emerging provincial legislation that was single issue or sector based
- Lack of research around social and economic linkages specific to Ontario
- Funding limitations
- Sustained public and political support. Need a better understanding of the *science of people* – their attitudes, values and knowledge of our ecology and how it relates to their lives and priorities

Most significant are the gaps that are associated with the mapping / data management, and the economic, social and ecological integration components. Improvements can be made to mapping and data management by providing resources for methodologies, platforms, ongoing training and easy dissemination. Some collaborations have begun to develop among key partners including provincial, conservation authorities, municipalities and non-government organizations. This work needs to become more consistent and broader in scope.

If we agree that ultimately the goal of IWM is to maintain and enhance watershed health which, in turn, links to human well being, then we need to shift towards greater economic, social and environmental integration if sustainability is to be achieved. We need to model how societies and economies function in the environment with each other and not independently. To achieve this, tools and methodologies need to be developed and key to the success is collaboration among all stakeholders (e.g. key levels of government, academia, and organizations with business interests).

We need to model how societies and economies function in the environment with each other and not independently.

In the Phase II Summary Report, Conservation Authorities reported that as they develop watershed and subwatershed studies, they rely on a number of typical components: scoping, characterization, management alternatives and plan development. However, they report there are clear gaps in the process having to do with developing targets, monitoring and evaluation implementation and updating plans. A shift to placing greater emphasis for setting and utilizing scientifically sound targets, monitoring and evaluation, implementation as well as updating plans is needed. This can be achieved by recognizing at the initial stages that time, funding and expertise must be accommodated. This will shift from being focused on just getting the watershed plan done to actually getting the plan implemented and being able to measure progress against goals, objectives and targets over time.

Shifts in Governance

As reported in the Phase I Summary Report, global shifts are occurring that can act as a catalyst for us to review and update the IWM concept.

We need to take a look at governance which, for the purposes of this study, is defined as "an effort to build, manage and maintain inter-organizational networks; in other words, develop an ecosystem institution". Various governance options are presented in Phase III Summary Report but the best fit appears to be an approach that recognizes the complementary roles of organizations involved in water management and associated natural resources – Adaptive Co-Management approach.

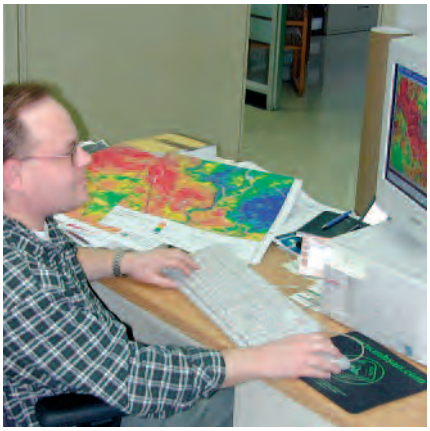
The key elements of Adaptive Co-Management include learning by doing, information sharing, collaboration and shared decision-making, partnering at regional and national levels and finally, flexibility in management approaches. This approach fits us best, given that the Ontario approach to IWM is already rooted in Adaptive Environmental Management.

Phase III Summary Report discusses details around how IWM should be used in Ontario, A series of questions are posed: What are the goals? Who should be involved and why? What information will be used and how? How will decisions be made? How will decisions be implemented? How will accomplishments be measured? What provisions will be made for learning and adaptation?

In addition to ensuring the environmental sustainability of our watersheds, it is equally important to note that IWM helps to build 'social capital' – the trust and relationships within and between social networks.

Considerations for Next Steps

The following considerations are offered following the work completed in Phases I, II and III of this initiative. They provide the next logical steps required to move the yardsticks forward in Ontario for managing on a watershed basis to ensure watershed health and human well being.



Collaborative Initiatives between Federal Departments, Provincial Ministries, Conservation Authorities and Municipalities:

1. Create a Watershed Management Working Group

- A quarterly forum for discussion on water issues that could include various levels and organizations such as the province's water directors, conservation authorities, municipalities and environmental non-government organizations about the use of tools addressing Enabling Factors, Management Instruments, Institutional Arrangements, and opportunties for IWM.
- Review and evaluate various collaborative governance models such as Adaptive Co-Management, Basin Agency etc. applicable to Ontario.
- Monitor the effectiveness of new and existing watershed planning initiatives, policies and practices, including international activities on Basin Planning in Australia and the European Union and provincial approaches from Quebec and Alberta.
- Reports on progress of working group.

2. Steps for further understanding Opportunities for federal/provincial agencies and their partners:

- Use existing forums for interagency discussions on how IWM could be applied. Examples include Great Lakes assessments, impacts of climate change at a provincial and local watershed level, data and data management, and connections to other initiatives e.g. Species at Risk Management Plans, Source Water Protection Plans.

- Host a Symposium on IWM every two years. See Appendix 7 on the results of the 2009 attendee survey which provides information on the content, duration, format etc. that a future symposium should take.

- Consult and evaluate with stakeholders on existing water policies to meet the needs of today and in the future.

- Hold discussions across departments on the models being used to assess the cumulative impact (ie: Ecosystem Based management, water budgets, Large Ocean Management Areas, etc.) with a view to updating and evaluating approaches on an ongoing basis.

3. Local Level Opportunities for Conservation Authorities and Municipalities

Hold working forums to:

- Educate staff and build a full understanding of IWM and opportunities and approaches developed over the last 10 years.

- Bring consistency to the IWM process amongst Conservation Authorities by reviewing and, if needed, improving standard approaches.

- Brainstorm on how to address barriers to IWM and utilize opportunities.

- Work with province and academia to carry out research needed to address gaps in IWM scientific components especially in the areas of target setting, social, economic and integration.

- Work with municipalities to assess local fit with Official Plans, Secondary Plans etc., develop effluent criteria for sewage treatment plants to meet assimilative capacities of receiving streams etc., develop stormwater retrofits etc.

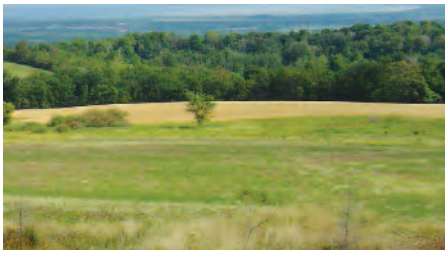
- Work with Environmental Non-Government Organizations (ENGOs) on implementation of long term projects and on issues of common concern.

- Work with interested parties to build a library of success stories where IWM is being used.

3.0 | Water Management Framework

Over the past ten years, we have witnessed the emergence of a number of water management issues in Ontario. While dominated by the Walkerton tragedy and the subsequent efforts to enhance the protection of drinking water, Ontario has also had to deal with significant droughts, Great Lakes issues, severe urban flooding, continuing urban development pressures and aging infrastructure. Overarching all of these are the pending implications of climate change on water resources.

The nature and scale of these issues suggest that there is both a need and an opportunity to develop a more coordinated approach to water management through a framework in the context of Integrated Watershed Management (IWM). IWM has been accepted internationally as an effective approach to managing water resources and is the cornerstone of Conservation Authority watershed-based programs.



3.1 What is a Water Management Framework?

A Water Management Framework is used to solve or address complex water and water related issues within a watershed. This tool can be equated with a blueprint or a scheme that allows us to outline a variety of functions occurring within a watershed and then analyze how they relate and impact on each other. A Water Management Framework is developed in order to address issues such as:

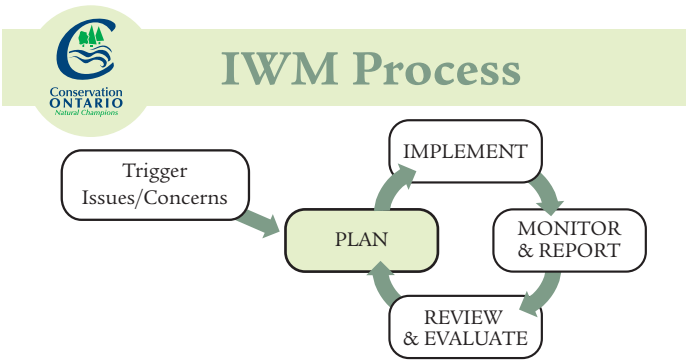
- Limits on surface and groundwater quantity and quality
- Many competing water users including ecosystems, municipalities, industries, etc.
- Many agencies with differing mandates

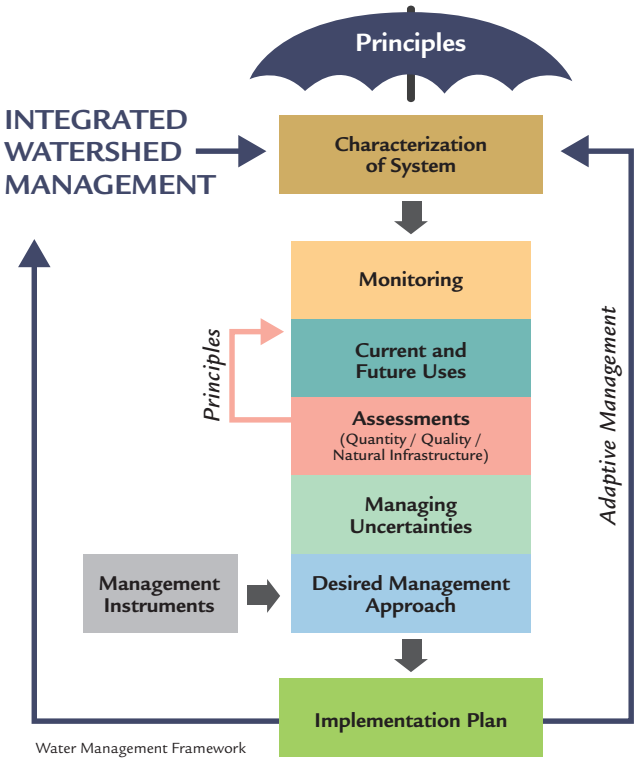
For the purposes of this report, five major water-related issues were identified around our current approach to water management in Ontario and act as drivers for a water management framework. These include:

1. Gaps in research knowledge
2. Insufficient monitoring information
3. Lack of capacity (staff & funding)
4. Lack of clarity around who does what
5. Fragmented legislation

3.2 Principles

Numerous examples of water frameworks exist and in order to sort through them and assess their usefulness to Ontario, a review was carried out by a project team and input was received from a number of water experts from a wide variety of sectors and agencies. From this review, we are able to identify a number of common principles that should be considered in developing a Water Management Framework for Ontario. These principles support sustainability, use the watershed as a management unit, and consider water management against other considerations such as land, water, human uses and ecosystem requirements. As well, other principles that need to be considered include the use of Adaptive Environmental Management which ensures transparency, flexibility and stakeholder participation; use of goals and the ability to develop a unique set of solutions for different systems and places.





Water Management Framework

3.3 Developing the Framework

The Water Management Framework would be applied as a natural subset within the Integrated Watershed Management (IWM) context. The IWM approach identifies water management and ecosystem issues which must be evaluated to determine their relative importance and to decide which issues will be addressed. IWM, when broken down into its core components, consists of water quantity, water quality and natural infrastructure. A Water Management Framework for Ontario focuses on water quantity and water quality with some connections to the natural infrastructure component as appropriate for water management only. The framework is intended as a practical guide to assist agencies with a mandate for water management to work together to fulfill their collective mandates to ensure a sustainable water resource for the Province of Ontario.

A Water Management Framework is being developed to promote a coordinated approach to management of water in order to maximize the resulting economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. The framework embraces an Integrated Watershed Management approach to water management planning. It should be noted that the water experts who were consulted on this work recommended to the project team that the framework which was originally referred to as the “Water Quantity Framework” should be renamed to “Water Management Framework”.

The proposed Framework outlines the planning direction for water management and intends to provide consistent direction while, at the same time, allowing for enough flexibility to address different situations. The Framework supports sustainable resource and environmental management as well as recognizes long term cumulative impacts. It is not intended to be a detailed plan, but rather it provides the general guidance for water management. The Framework should be reviewed and updated on a regular basis.

3.4 Elements of the Water Management Framework

Characterization of System

Within an IWM context, this framework requires us to characterize the water system, which includes defining the forms and functions of the water system, identifying water management issues, prioritizing needs and establishing goals and objectives for water management. The availability of watershed and subwatershed plans can provide this information from a larger context and can be scaled up or down as well as augmented depending on the scale of the analysis.

Characterization also includes identifying natural features, linkages, surface and groundwater systems, plus quantifying precipitation, and assessing existing flow regimes, recharge areas, and identifying interconnections between aquatic, terrestrial and groundwater systems, buffers and linkages. It also examines constraints to flow including floodplains, steep slopes, erosion areas, wetlands, forests, habitat, corridors, buffers and wellheads.

Any goals and objectives that are established during the characterization phase must reflect that there are limits to changes that the ecosystem can withstand and that these limits should be considered before mitigation measures and developed to accommodate future changes. Adverse effects of our activities cannot always be eliminated through mitigation. To ensure accountability and map progress, monitoring must take place within the water management framework.

Monitoring

There are two requirements to monitoring within the Water Management Framework. The first is to provide measurements of water supply and water demand. The second is to move towards performance monitoring of the implemented water management plans.

Current and Future Uses

Sustainable water and resources management must include the determination of existing and future water uses. Sustainability reflects both the demand and supply side of water and assessments are used to determine these requirements. Water budgets are one of the tools that allow us to determine the status of supply and demand within a watershed.

Assessments

Assessments are used to determine that status of water demand and water supply as well as include quantity and quality considerations. Status reflects whether supply is greater than, equal to, or less than demand. Any water management plan must acknowledge the status of demand and supply in order to select alternatives that - in the long term - are sustainable.

Managing Uncertainty

There are many uncertainties when managing water ecosystems including incomplete and insufficient data, gaps in scientific theory in models and unknown effects of cumulative and multiple stressors in large scale and long term scenarios.




Management Instruments

Each issue will require different solutions and a series of Management Instruments have been developed to solve a wide range of issues:

- Legislation
- Policies and programs
- Watershed plans
- Collaborative partnerships
- Institutional roles
- Education/stewardship
- Conflict resolution
- Economic considerations

Desired Management Approach

The desired management approach will pull together the best information, address the needs of the ecosystem, involve all stakeholders, recognize and acknowledge uncertainties, recognize cumulative effects and use Adaptive Environmental Management.

Implementation Plan

An implementation plan or Water Management Plan is developed cooperatively to address single or a broad range of issues. These plans can recommend allocation, conservation, restoration, etc. They can include Source Protection Plans, Water Conservation Plans, Water Demand Plans, Water Efficiency Plans, Stormwater Management Plans and Nutrient Management Plans.

Water Management Plans should follow the Framework principles and include a summary of the issues, a description of the area, a summary of the data, consideration of the relationship of the Water Management Plan to regional strategies or other planning initiatives, recommended options and strategies to address the issues, and a list of performance monitoring requirements to ensure accountability. Lastly, a feedback loop to IWM is needed to ensure that the watershed plan is updated and that the actions associated with the Implementation Plan is consistent with the long-term watershed goals and objectives.

3.5 Considerations for Next Steps

1. The Water Management Framework developed for this project should be reviewed and considered by key water management agencies in the Province of Ontario.

2. A strategy should be developed by key water management agencies to:

- Gain internal understanding and support within each agency;
- Gain external support and understanding that reflects the different layers of decisions made in government (e.g. at the provincial, federal, municipal, etc.);
- Articulate how the Framework integrates with other existing frameworks (such as those used for water taking etc.) which allows for effective decision making;
- Assess the need for tools e.g. Memoranda of Agreements, guidelines etc.

A working committee should be struck amongst key water management agencies to develop the next steps towards water management. Consultation should occur with other key agencies early in and throughout the process at the federal, provincial and municipal levels.

3. Working Groups should be struck to consider key technical issues including:

- Refinements to the proposed Water Management Framework;
- Water Rights approaches;
- Information, Data and Monitoring needs; and
- Governance (how will agencies collaborate and interact with each other).

4.0 | Water Budget Overview

In order to properly protect water and related land resources, we need to understand what is going on with Ontario's water – both on the surface and below ground. One tool we use to help us assess and evaluate how best to protect local water quantity and quality is a water budget.

Not unlike a household budget that looks at how much money we make as a whole and then guides us on how much we can spend by looking at expenses today and in the future, a water budget looks at how much water enters a watershed, how it's stored and how much water leaves. It also looks at what we are doing on the land that impacts water quality and quantity and then this information helps us to determine how much water is available for human uses while ensuring there is still enough left for natural processes. This is done on different scales assessing it against our requirements today and what we think we will need for the future.

The Water Budget Overview provides a general understanding of water budgets and the water cycle; it provides a background review of policy and legislation; and it allows for a more detailed analysis of how we use water budgets in Ontario and globally.

The information provided in this overview was obtained from readily available information found online, informal and workshop discussions, plus the results from a survey carried out with Ontario's 36 Conservation Authorities. The intention of the overview is to provide a summary of the technical feedback and provide recommendations for a guidance document (beyond what currently exists for the Drinking Water Source Protection Program), for a governance structure and performance measures.

Water budgets help us to look at how much water enters a watershed, how it's stored and how much water leaves.

4.1 What is a Water Budget?

A water budget is a basic tool that can be used to evaluate the occurrence and movement of water through the natural environment. Water budgets provide a foundation for evaluating its use in relationship to other important influencing conditions such as other ecological systems and features, as well as social and economic components – how much water is being used by industry, residents, etc.

The water budget process can encompass various levels of assessment which start simple and grow more complex if there are concerns about how much water is available at any level. The higher the 'tier', or level, the more complex the science involved and the narrower the geographic focus.

Water budgets commonly go well beyond how much water is available and where it is. They also include a detailed understanding of the flow dynamics. These flow dynamics include the origin and movement of both groundwater and surface water as well as the interaction between the two systems. This overall interdependent understanding is necessary for sound water management.

Water budget studies consider the volumes of water within the various reservoirs of the hydrologic cycle and the flow paths from recharge to discharge. Water budgets need to consider this information on a variety of spatial and temporal scales.

4.2 Hydrological Cycle – Our Water Cycle

We have a finite supply of water and it moves within the hydrologic cycle, or water cycle within a watershed. In order to ensure a sustainable supply of water within the water cycle, we need to pay attention to what is happening on the land and how that impacts our natural environment. Precipitation reaching the land surface is impacted and distributed in numerous ways. Any precipitation that falls within the watershed is influenced by physical characteristics of the land, air pollution, and land uses.

By developing a snapshot of the physical watershed we can determine where water sources are located, how much water is being used, how much is being stored, and where the important recharge areas are located (where surface water and groundwater interact). The way water moves in a watershed relies on the typography of the land, types of soils, etc. Excess water can be stored in a watershed – in low areas or below ground – slowly being released over time during drier periods. However, overuse or contamination of these sources of water significantly impacts the quality and amount of water we have available. The amount of water available in a watershed is not infinite and it is susceptible to stress – there is only so much that is recycled through the water cycle. If we use too much water – faster than it can be replenished naturally – it impacts the amount available today and in the future.

4.3 Technical Aspects of Water Budget Assessments

The level of detail incorporated into any water budget analysis depends on the study objectives and the data available. In a natural state an unstressed basin experiences negligible long term changes in land surface, soil moisture and groundwater storage. However, this is not always the case. Also, groundwater flows as well as impacts of human activities can result in water moving between watersheds (i.e. inter-basin flow) and may be difficult to adequately quantify.

It is suggested that as an initial approach that water budgets start in a more simplistic state where storage changes and natural inter-basin flows are ignored. It is also suggested that average saturation state conditions be analysed. This means that input data and calibration targets represent average climate conditions, average groundwater levels and average streamflow conditions. This provides an initial understanding of the system and allows managers to examine how water is balanced by using these simplifications. Future analysis could build on this initial understanding to determine the nature of inter-basin transfers and storage changes as well as the hydrologic response of the basin to low and high saturation states. If significant, these components would then be incorporated into a refined water budget. In this way the water budget and, indeed, the overall understanding of water movement within the watershed is quantitatively improved over time as more data becomes available and re-assessed.

We do not have an infinite supply of water.

4.4 Water Budget Modeling

A conceptual water budget model is first developed to obtain a basic understanding of the physical flow system. An initial synthesizing of the available data can be used to gain an appreciation of the various fluxes in the watershed. This initial work may indicate where critical data gaps exist.

The use of *numerical modelling* can provide a more refined understanding of the flow system including both surface and groundwater. Numerical models are tools used to simplify the representation of these processes and enable quantification and evaluation of the hydrologic system at various levels – watershed, subwatershed and site scale. Although these models can provide hard quantitative values, it is important to recognize the uncertainty in numerical modeling and use the models appropriately in making water management decisions.

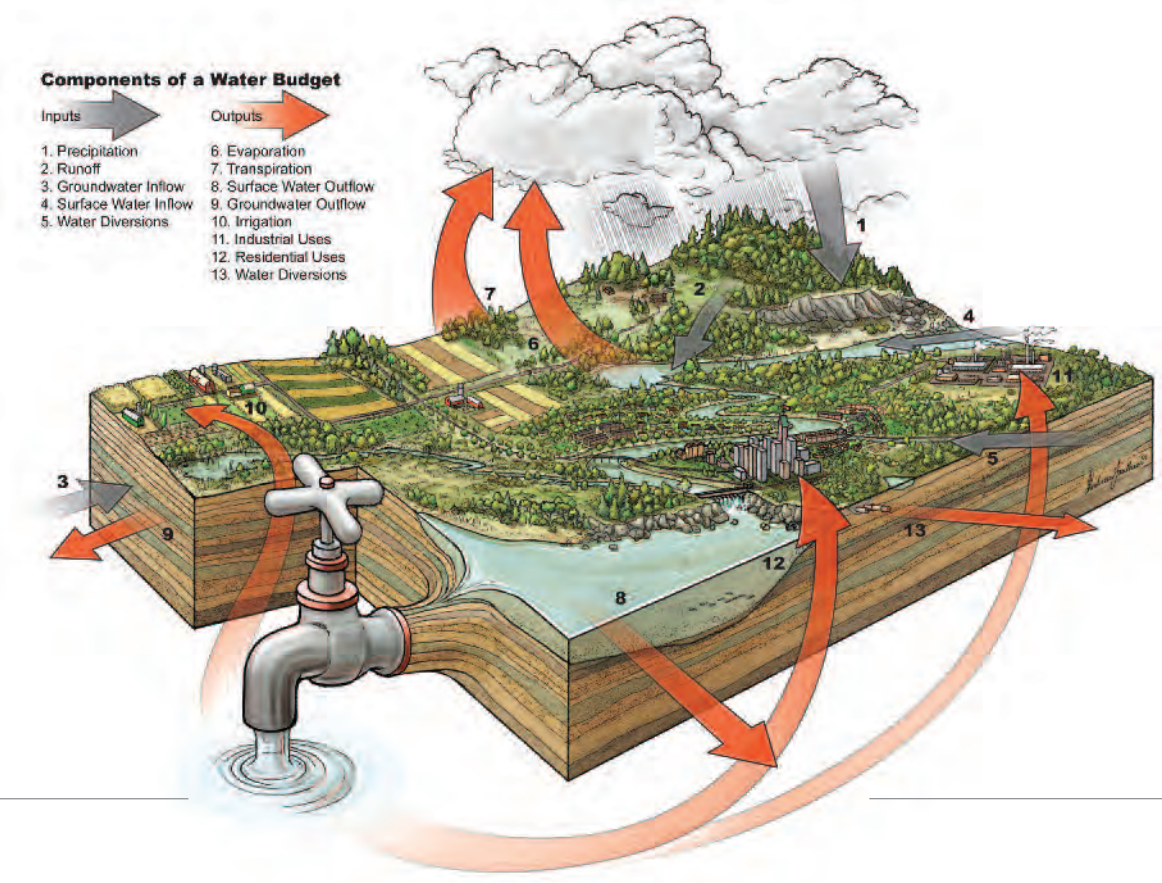
The most appropriate model for water budget analysis will depend primarily on the dominant flow processes (surface water or groundwater). If changes in the groundwater discharge will significantly affect the flow of a river, then the model used should simulate the complexities of the groundwater system. If flow in the river is most affected by surface runoff and through flow during and following storm events, then the model must be able to simulate the complexities of the surface water processes. In Ontario, most changes in groundwater discharge and storm event processes will affect the flow in the river such that linking surface water and groundwater models, or the use of conjunctive models is most appropriate for water budget analysis.

4.5 Water Budget Limitations

There are a number of considerations to be evaluated to ensure effective utilization of the water budget. Generally they are related to whether or not there is understanding of the necessary physical data of sufficient quality to build a conceptual model; as well as calibrate a numerical model that is capable of representing the physical processes at play.

4.6 International Water Budget Overview

Although limited information on the use of water budgets from a global perspective was found, some information was gathered on Australia, Great Britain, European Union and the United States. A substantial amount of work would be expected to be carried out in these areas as a result of climate, demand for water and intensity of historical and future development. Further research is needed to gather the technical documents that have been completed.



4.7 Ontario Water Budget Overview

Water budgets in various forms and levels of complexity have been carried out in the province dating back to the 1960's in basin studies under the management of the Ontario Water Resource Commission. Although carried out in inconsistent fashion, water budget studies have also and continue to be carried out on various scales for land use and water use developments. As well, watershed and subwatershed studies carried out in the 1990's commonly presented basic water budgets but there was no consistent methodology.

To protect municipal drinking water sources in the province, the Province of Ontario has mandated the production of locally developed, science-based source water assessment reports and protection plans. This is being done through the *Clean Water Act* (2006). These reports require Conservation Authorities to conduct water budgets. The level of detail of the water budget characterization depends on the associated risk assessment process. As of mid 2009, the Ministry of Natural Resources has reported that all of the Conservation Authorities have carried out Conceptual Water Budgets, the first of four possible levels. A number of higher Tier 2 and Tier 3 Water Budgets have been or are in the process of being completed. These water budgets are being utilized for the management of municipal water supplies.

The technical approach to watershed and subwatershed water budgeting most commonly used in the province is the integration of surface water and ground water models.

In order to improve our understanding, methodology and implementation relating to water budgets, the Conservation Authorities and the Ministry of Natural Resources has developed an interim strategy promoting and conducting research initiatives focused on watershed-based management activities. The four themes covered by this research include:

1. Water Quantities and Their Movement Within the Hydrologic Cycle
2. Landscape Characteristics Influencing the Movement of Water
3. Water Quantities and Their Relation to Biological Communities
4. Human Modification of the Hydrologic Cycle

Results from the research projects and assessments will greatly improve the knowledge gaps within Ontario's current water budget process.

4.8 Uses of Water Budgets

In addition to protecting sources of drinking water, water budgets can be used for a number of land use and water use developments including: Permit to Take Water applications; landfill site approvals; residential or industrial development; municipal water supplies; aggregate extraction; dam construction; stormwater management; and irrigation.

More specifically, they can be used:

- to set water allocation targets and recharge rates within local watersheds;
- as a decision-making tool to evaluate land and water uses such as restoration and rehabilitation projects identified in management plans;
- evaluate the cumulative effects of land and water uses within watersheds;
- to provide a watershed scale framework for site scale studies (e.g. evaluation of a sewage & water system plan);
- to help make informed decisions about the design of environmental monitoring programs; and
- to assist in setting targets for water conservation.

In order to use the water budgets to their full potential, as the science unfolds and resources are available, we need to address current knowledge gaps, data gaps and issues; and they need to be addressed on an ongoing basis.

4.9 Considerations for Next Steps

1) The technical aspects of the knowledge gaps described above are not just common to Ontario but reflect the world wide state-of-the-science. As such it is recommended that Ontario keep apprised of the ongoing work within the national and international academic and consulting community as it relates to:

   a. baseflow quantification;

   b. recharge quantification;

   c. aquifer mapping; and

   d. instream flow needs.

2) Access should be provided to a description of all the technical initiatives, both historical and ongoing, in the province which may aid in carrying out water budgets (i.e. monitoring databases, releasing findings on new methodologies or models, basic research etc.).

3) A hydrological monitoring database framework should be developed that provides practical and timely access to standardized data; and resources to convert and input non-electronic data (i.e. hardcopy hydrographs, borehole logs, groundwater chemistry, baseflow data etc.) into the database.

4) A group or agency should be designated to maintain and provide an additional level of assessment of the knowledge gained from water budgets (i.e., building a cumulative understanding of how much water is moving and where). See Water Management Framework Report.

5) Carry out a detailed review of completed and ongoing water budget studies to assess scheduling, human resource and financial needs and deliverables in the context of expected results versus actual results. This will provide direction on future resource needs to complete technically sound studies.

6) Carry out a review, assess the spatial and temporal gaps and provide additional monitoring for:

   a. climate data;

   b. groundwater level data;

   c. streamflow; particularly baseflow; and reach specific discharge;

   d. evapotranspiration data;

   e. accurate water takings; and

   f. aquifer characteristics.

7) Ensure higher level water budgets are carried out in the remaining subwatersheds in the province that were not addressed through the Clean Water Act, Oak Ridges Moraine Act, and the Lake Simcoe Act to provide information to assess cumulative effects, irrigation, flood control etc. See Water Management Framework Report under separate cover.

8) Continue to improve technical methodology to assess water budgets on a local scale (i.e. plans of subdivision to better manage storm water) and incorporate into an ongoing larger scale assessment.

DEFINITIONS

Aquatic Ecosystem: An aquatic ecosystem refers to a community of organisms (bugs, plants, wildlife, surroundings) that live in water and are dependent on each other for survival.

Aquifer: An underground layer of permeable rock, sediment (usually sand or gravel), or soil where groundwater is stored. Aquifers are connected to other aquifers and surface water bodies and can occur at various depths.

Biodiversity: Refers to the uniqueness and variability of all life with particular emphasis on genes, species, landscapes or ecosystems.

Ecosystem: A dynamic complex of organisms and their associated non-living environment, interacting as an ecological unit composed of primary producers, consumers and decomposers.

Elasticity: Refers to the ability of an ecosystem to accommodate change while maintaining its structure and function.

Ecological resilience refers to the capacity of natural ecosystems, social resilience to the capacity of human communities to cope with change.

The term **ENVIRONMENT** as used in this document refers to the natural components of aquatic ecosystems, the flora and fauna, and the natural ecological processes that take place between individual plants and animals, their surroundings, and between each other. The maintenance of species biodiversity, community structure and functioning and natural ecological processes are important elements (and indicators) of the maintenance of overall environmental integrity.

Ecological Values are defined as the natural ecological processes occurring within water dependent ecosystems and the biodiversity of these systems.

Environmental Water Requirements are descriptions of the water regimes needed to sustain the ecological values of aquatic ecosystems at a low level of risk. These descriptions are developed through the application of scientific methods and techniques or through the application of local knowledge based on many years of observation.

Environmental Water Provisions are that part of environmental water requirements that can be met.

Environmental Water Provisions may refer to:

- unregulated flows in rivers and water in wetlands and aquifers;
- specific volumetric allocations and/or releases from storages;
- water levels maintained in wetlands; and
- water in transit for other users, the pattern of flow of which may be defined to meet an environmental need.

Complexity: A feature of systems that comprise diverse components among which there are many interactions, the resulting implications of which are often unpredictable.

Cumulative Impact: The incremental impact of an action on the environment when the impacts are combined with those from other past, existing and future actions.

Driver: Any natural or anthropogenic factor that causes change within a system, whether through direct or indirect means, regardless of whether it is internal or external to the system.

Erosion: The wearing away, by water, of the banks or bed of a stream or of the materials used in any works.

Green Infrastructure: An interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations.

Impact: Any aspect of an action that may cause an effect; for example, land clearing during construction is an impact, while a possible effect is loss and fragmentation of wildlife habitat.

Impact Model: A formal description of a cause-effect relationship that allows the assessing of various components of that relationship through the use of an Impact Statement, a Pathways Diagram, and the validation of linkages and pathways.

Indicator: Anything that is used to measure the condition of something of interest. Indicators are often used as variables in the modeling of changes in complex environmental systems.

Infrastructure: An underlying base or foundation especially for an organization or system. The basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions including schools, post offices, and prisons.

Integrated Management: An approach to management through which multiple actors collaborate and share risk in defining, analyzing, and resolving social ecological challenges for the common good. This approach moves beyond conventional single-species management to consider the implications of, species interactions, habitat and ecosystem linkages, and cumulative effects.

Mitigation: In the context of climate change, a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Examples include: using fossil fuels more efficiently for industrial processes or electricity generation, switching from oil to natural gas as a heating fuel, improving the insulation of buildings, and expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere.

Precautionary Principle: See the report, Integrated Watershed Management in Ontario (Phases I - III), Appendix 4.

Resilience: Refers to the capacity of an ecological or social system to accommodate change, stress and variability without altering its structure and function.

Riparian Zone: The riparian zone is the area between the land and a surface water body. Plants alongside the banks of the water body are called riparian vegetation and are important for the health of the stream and to stop bank erosion.

Robust Management: Management that is designed to ensure an acceptable level of performance despite conditions of elevated scientific uncertainty and limited control over exploitation.

Social Capital: The social norms, networks of reciprocity and exchange, and relationships of trust that enable people to act collectively.

Social Learning: The collaborative or mutual development and sharing of knowledge by multiple stakeholders through learning-by-doing.

Stakeholders: Individuals or groups (including government and non-government institutions, communities, research institutions, development agencies, etc.) with an interest or claim.

Surface Water: Surface water is the water that runs over or sits on the land. This includes lakes, rivers, streams, creeks and ponds. It is usually fresh water and it is not stored in the ground.

Threshold: The critical boundary (e.g. spatial or temporal) where the attraction of a system to a new equilibrium or configuration supersedes the system's attractions to its current state.

Watershed: The region or area of land that drains into a river, river system, or other body of water. Watersheds are divided by mountains or hill ridges.

Water Dependent Ecosystems: Those parts of the environment, the species composition and natural ecological processes of which are determined by the permanent or temporary presence of flowing or standing water. The instream areas of rivers, riparian vegetation, springs, wetlands, floodplains and estuaries are all water dependent ecosystems.

Water Flow Requirement: Water flow requirement refers to the amount of water that nature (fish, wildlife, streams) needs in a water body so that it can function properly. Water flow requirement needs relate to adequate water flow, water quality, riparian margins and water temperature.

Wetland: Wetlands refer to a body of land saturated by water and include swamps, marshes and bogs. Wetlands are the interface between land and aquatic ecosystems and usually support diverse forms of life and provide significant benefits to the environment.

www.conservationontario.ca