

SUBWATERSHED PLANNING

June 1993



Subwatershed Planning

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Un résumé de cette publication est disponible en français.



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TABLE OF CONTENTS

Page:

LIST OF FIGURES	iii
LIST OF TABLES	iii
ACKNOWLEDGMENTS	iv
USING THIS DOCUMENT	iv
EXECUTIVE SUMMARY	v
1.0 BACKGROUND: THE NEED FOR CHANGE	
1.1 Evolution of Watershed Planning	1
1.2 Need for Planning on a Watershed Basis	3
1.3 Relationship of Watershed Planning to Land Use Planning	3
1.4 Environmental Assessment Principles	9
2.0 SUBWATERSHED PLANS	
2.1 Why do Subwatershed Planning?	10
2.2 What is a Subwatershed Plan?	13
2.3 Subwatershed Plan Boundaries	14
2.4 Multidisciplinary Plan Preparation	16
3.0 PLANNING FRAMEWORK	
3.1 Overview	16
3.2 Set the Stage	18
3.3 Prepare the Plan	19
3.4 Adopt the Plan	23
4.0 TECHNICAL ASSESSMENT	
4.1 Overview	23
4.2 Staging Plan Development	24
4.3 Phase 1	25
4.3.1 Steering Committee Direction	25
4.3.2 Identification of Natural Features, Processes and Linkages	28
4.3.3 Steering Committee Input	28
4.3.4 Public Review and Input	28
4.3.5 Identify Subwatershed Opportunities	28
4.3.6 Other Land Use and Servicing Studies	29

TABLE OF CONTENTS

(Continued)

	<u>Page:</u>
4.4	Phase 2 29
4.4.1	Input from Other Studies 29
4.4.2	Technical Assessment of Natural Systems and Hydrologic Processes 29
4.4.3	Setting Targets and Constraints 30
4.4.4	Developing Subwatershed Management Alternatives 30
4.4.5	Evaluating Alternatives 30
4.4.6	Finalizing the Subwatershed Plan 30
5.0	INFORMATION NEEDS 31
6.0	PUBLIC PARTICIPATION 34
7.0	MONITORING PROGRAMS 36
8.0	FUNDING 37
9.0	SUBWATERSHED PLANS: BALANCED BENEFITS 38

LIST OF FIGURES

FIGURE 1	-	EVOLUTION OF WATERSHED PLANNING	.....	2
FIGURE 2	-	CREDIT RIVER SUBWATERSHEDS	.....	4
FIGURE 3	-	WATERSHED PLANS	.....	5
FIGURE 4	-	SUBWATERSHED PLANS	.....	6
FIGURE 5	-	SITE MANAGEMENT PLANS	.....	7
FIGURE 6	-	WATERSHED AND MUNICIPAL PLANNING	.....	8
FIGURE 7	-	PLANNING FRAMEWORK	.....	17
FIGURE 8	-	PHASE 1 ACTIVITIES	.....	26
FIGURE 9	-	PHASE 2 ACTIVITIES	.....	27

LIST OF TABLES

TABLE 1	-	COMPONENTS OF A WATERSHED PLAN	.....	15
TABLE 2	-	SUGGESTIONS FOR INFORMATION NEEDED IN A SUBWATERSHED PLAN	.....	32

ACKNOWLEDGMENTS

The development of the discussion in this document, and two other related documents in this series, resulted from the thoughts, efforts and collaboration of a range of people from a number of government ministries and the private sector. The work built upon the efforts of interagency groups and committees who were involved in various water management activities, and in developing this concept over several years. Contributors to this new direction for provincial water management included staff of the Ministries of Environment and Energy (MOEE), Natural Resources (MNR), Municipal Affairs (MMA), and Conservation Authorities. Representatives of a number of municipalities and engineering professionals from the consulting community and development industry in the private sector also contributed to this work.

The Provincial Urban Drainage Advisory Committee, an interagency group, has been a part of the evolution of watershed planning over the years. Also, the Waterloo Master Watershed Planning Committee, another interagency group, deserves mention as one of the first such groups to embark on watershed planning in the province.

At further stages, evolution of the concept of watershed planning also built on practical experience by some local agencies in watershed/subwatershed planning, and in the integration of this planning with municipal planning, notably in the Grand River and Credit River watersheds.

USING THIS DOCUMENT

The concepts and practical suggestions in this interim document are intended to assist those undertaking watershed planning in their communities, and to assist in the consistent application of provincial programs. This guidance is being provided to resource managers, planners and stakeholders for use over the next two years. During this time, provincial agencies will seek ways of effectively applying relevant programs and legislation to the development and implementation of watershed plans. Provincial participants in the watershed planning process will monitor how the ideas in these documents are used during the interim period, evaluating the processes used and the results achieved. Finally, on the basis of this experience, MOEE, MNR and MMA will develop optimum methods and processes for applying water management policies in the municipal land use planning process.

The suggestions here encourage municipalities to work together to address cross-boundary issues on a watershed basis. This approach is consistent with proposals found in other related documents on this matter, including: Draft Report on Planning and Development Reform in Ontario, Commission on Planning and Development Reform in Ontario; Streamlining Guidelines: The Development Review Process, Ministry of Municipal Affairs and Ministry of Housing; Growth and Settlement: Policy Guidelines, Ministry of Municipal Affairs; Cross-Boundary Issues in South Central Ontario: A Discussion Paper, Ministry of Municipal Affairs.

EXECUTIVE SUMMARY

During the 1980s, there were growing concerns, on the part of the public and government, about the natural environment and, therefore, about ecologically sound management of natural resources, particularly in urbanizing areas. There were some improvements to resource management, development and engineering design and land use planning, but this was done in a relatively ad hoc way. It is now recognized that sound environmental management is important for the economic health and stability of successful communities.

A general integrated approach to resource management and land use planning that is endorsed by everyone involved can promote consistency and efficiency in both these processes. There are, of course, many environmental benefits of this approach, but economic benefits will also be realized as costs for remediation and cleanup strategies are expected to correspondingly decrease. There are additional economic benefits to Ontario, less directly, of a clean and healthy environment.

Subwatershed plans provide important information to the land use decision-making process for the use and management of water and land that compatibly integrate natural systems with changing land uses. Subwatershed plans should reflect the goals of the watershed plan (if there is one), but are tailored to tributary needs and local issues, and provide detailed guidance on site-specific water resource planning issues.

This discussion sets out why, when, and how to prepare subwatershed plans; it is intended for the use of all who work in the fields of resource management, land use planning and land development, and for anyone interested in these issues. Its purpose is:

- P To **promote an ecosystem-based approach** to environmental and land use planning at a subwatershed level.
- P To **foster early, integrated planning** for land use, water management, and environmental protection and management on a subwatershed basis.
- P To **assist government and municipal agencies, consultants and the development industry** who may be involved in or working in the context of subwatershed planning.
- P To **enhance the efficiency and effectiveness** of the land use plan preparation and review process.

1.0 BACKGROUND: THE NEED FOR CHANGE

1.1 Evolution of Watershed Planning

As watershed plans and programs were completed and endorsed in southern Ontario in the early 1980s, the Master Drainage Plan was promoted and subsequently recognized as the preferred mechanism for the planning and design of urban drainage systems to minimize impacts of urban stormwater runoff on receiving watercourses. Although these Master Drainage Plans often recognized the importance of meeting broader environmental objectives of the watershed plans, they generally addressed only the quantity of urban runoff and its impacts and influences on flood control, erosion control and major/minor system design. In the mid-to-late 1980s, a fundamental change occurred when the requirement to address the quality of runoff from urbanizing areas was introduced. Initially, water quality concerns focused on sediment control during construction. In addition, the importance of treating storm runoff for water quality in order to address fisheries protection and other water use issues was recognized.

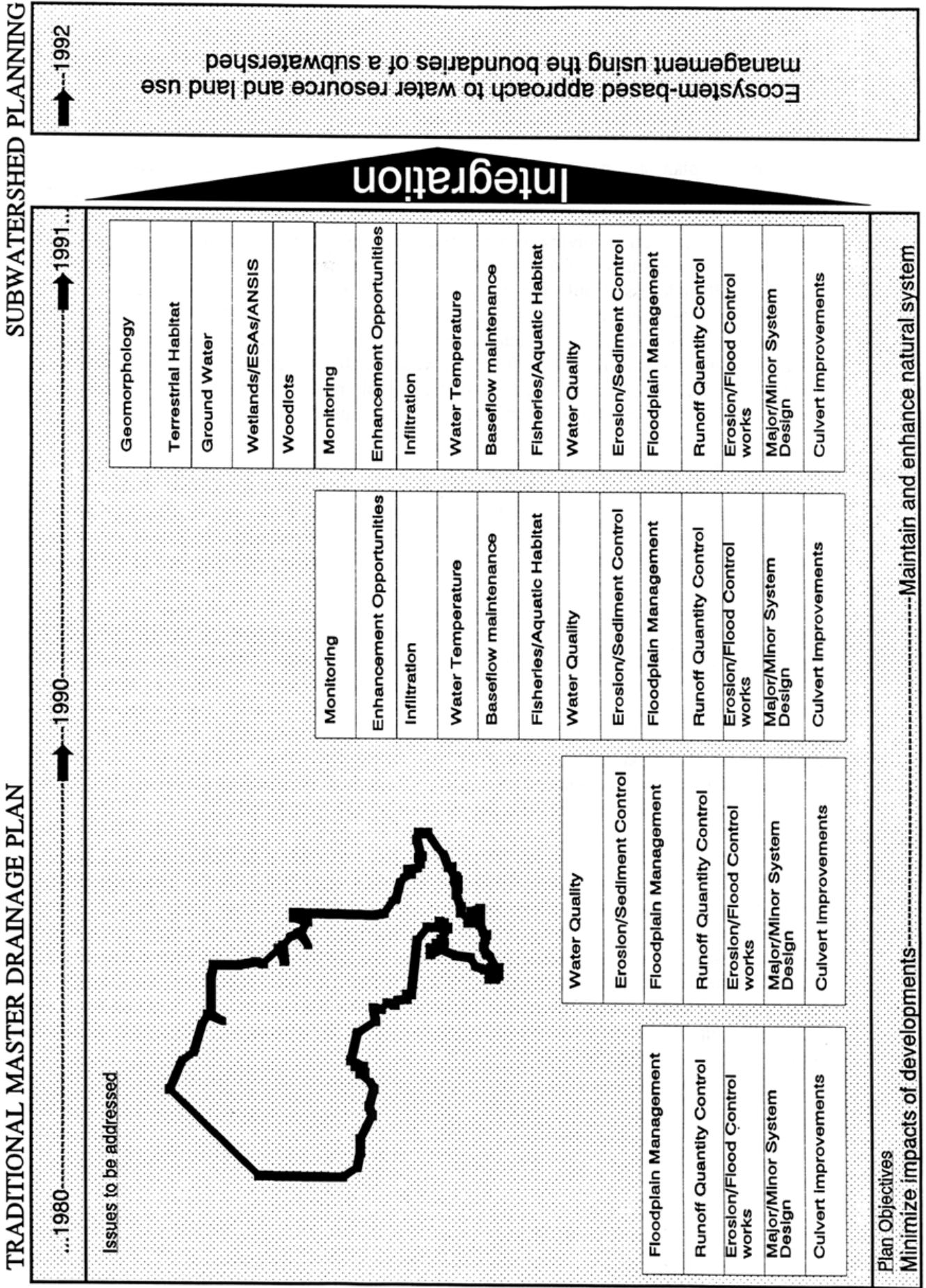
Concerns for the protection and enhancement of the aquatic environment in general and fisheries resources in particular (as it relates to their value as an environmental indicator), grew to encompass a broader range of issues to be addressed including the maintenance of baseflow, cool water temperature, and stream geomorphology, etc. More recently, the protection of terrestrial resources and ground water systems has introduced new areas of study into these analyses and urban designs.

Figure 1 schematically presents the increase in issues addressed in Master Drainage Plans throughout the 1980s and early 1990s. As illustrated, Master Drainage Plan issues grew from five engineering drainage related issues in the early 1980s to some 18 issues in 1990. By the late 1980s, there was the expectation that Master Drainage Plans should go beyond mitigating impacts associated with development to make recommendations for the protection and enhancement of the natural resources/features. These new objectives and approaches to Master Drainage Plans were influenced by the concepts of ecosystem planning and sustainable development that gained profile and support during this same period.

However, the timeframe of Master Drainage Plans and their relationship to land use planning remained limited. In the early 1980s, more often than not, Master Drainage Plans were undertaken after development plans had been established and carried some formal or perceived development rights. Also, until recently, these studies were based on parcels of land proposed for development. Increased public awareness of the environment, and the release of milestone reports by the Royal Commission on the Future of the Toronto Waterfront, the Greater Toronto Greenlands Strategy, and numerous reports by the Environmental Assessment Advisory Committee supported initiatives by provincial agencies for a change in the scope, objectives and timing of Master Drainage Plans.

FIGURE 1

EVOLUTION OF WATERSHED PLANNING



The term Subwatershed Plan, then, appropriately conveys the adoption of an ecosystem-based resources management strategy and the use of subwatershed boundaries for technical studies and land use planning.

1.2 Need for Planning on a Watershed Basis

The Conservation Authorities Act of 1946 established "conservation authorities" with jurisdiction over natural areas based on watersheds. The scientific community recognized the importance of watersheds a decade ago. Recent reports by the Royal Commission on the Future of the Toronto Waterfront, "Watershed" (1990) and "Regeneration" (1992), promoted the concept that watersheds serve as natural and logical boundaries for modern approaches to urban environmental and land use planning.

Subwatershed planning is not the same as master drainage planning with an "environmental touch-up." It is a more complex but much fairer assessment of interactions of natural processes within broader boundaries, and of the interactions between those natural processes and man-made social and economic demands. The term "subwatershed planning," then, more appropriately conveys the ecosystem-based approach to water resource and land use management using the boundaries of a subwatershed.

This approach, using watersheds and subwatersheds for land use and resource management is appropriate for a number of reasons. Water continuously moves through watersheds and influences numerous life cycles and physical processes throughout its cycle. An action or change in one location within a watershed has potential implications to many other natural features and processes that are linked by the movement of surface and ground water. Also, of course, water movement does not stop at political boundaries, so that watersheds and subwatersheds may encompass all or part of several municipalities.

Subwatershed plans can promote the clear environmental benefit of limiting urban sprawl by focusing effort in selected parts of the subwatershed.

Watershed-based management strategies progress from broad large-scale studies (watersheds) to more detailed studies covering smaller geographic areas within the watershed (subwatersheds), as shown in Figure 2. Various watershed management studies (watershed plans, subwatershed plans, site management plans) are described in Figures 3, 4 and 5.

1.3 Relationship of Watershed Planning to Land Use Planning

Improper land use practices do not impact just water, but the entire watershed system, whatever its size. Figure 6 illustrates the relationship between watershed planning and the land use planning process, using existing mechanisms. In the present situation, the mechanisms and their order and relationship are as shown; what is currently missing is the undertaking of these levels of resource management and land use planning in a truly integrated manner.

FIGURE 2
CREDIT RIVER SUBWATERSHEDS

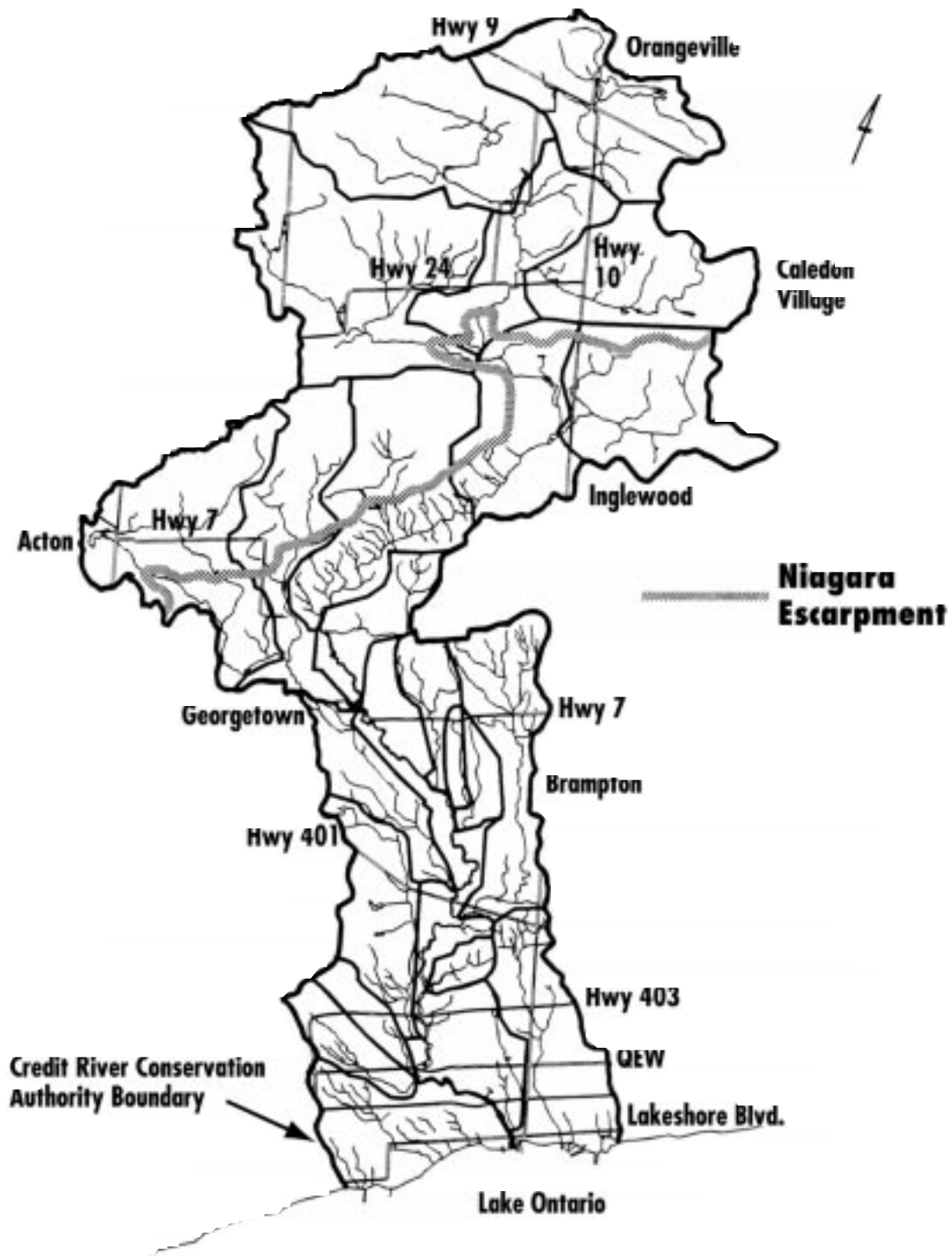


FIGURE 3
WATERSHED PLANS



- will take a broad ecosystem approach to water, water related natural features, terrestrial resources, fisheries, water dependencies/linkages and valley/open space systems
- will provide watershed-wide policy and direction for:
 - ecological integrity and carrying capacity
 - the protection of valley systems and green space planning
 - the management of water quantity and quality
 - aquifer and ground water management
 - fisheries management
 - rehabilitation/enhancement programs
 - a framework for implementation of watershed policies and programs
 - regional opportunities/constraints
 - document servicing needs/availability of water/sewerage
- will delineate subwatershed planning areas
- present targets, goals and objectives for subwatershed

PLAN RECOMMENDATIONS TO BE INPUT TO OFFICIAL PLANS

FIGURE 4
SUBWATERSHED PLANS



- enhance detail to address local environment issues
- will detail and implement specific subwatershed targets, goals objectives to establish:
 - natural system linkages and functions
 - surface and ground water quantity and quality management
 - the enhancement, rehabilitation of natural features
 - areas suitable for development
 - best management practices for incorporation into subdivision designs
 - specific implementation schemes and responsibilities for all recommendations
 - management practices for open space areas and green space corridors
 - an implementation strategy
- will outline directives for stormwater management plans and other studies/designs for specific areas within the subwatershed
- future monitoring requirements will be outlined

**PLAN RECOMMENDATIONS TO BE INCORPORATED
WITH OFFICIAL AMENDMENTS**

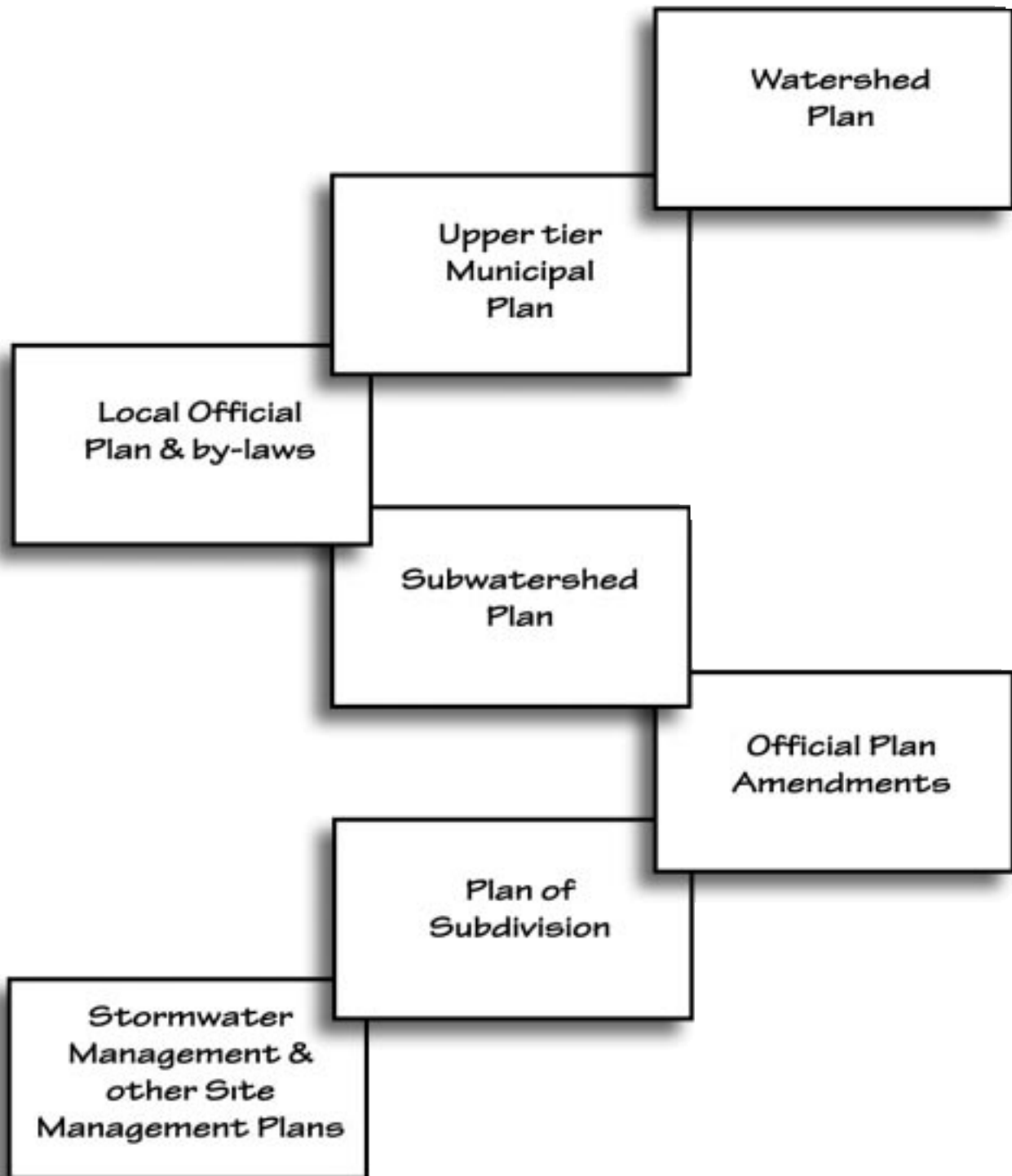
FIGURE 5
SITE MANAGEMENT PLANS



- will present the designs of specific best management practices, subdivision drainage designs, details of enhancement or rehabilitation programs
- will demonstrate compatibility of designs with subwatershed plan recommendations
- may include permits and applications for construction approvals
- may include requests for clearance of draft plan conditions
- may identify need for specific environmental assessments
- may detail design, operation and maintenance of Stormwater Best Management Practices

**PLAN RECOMMENDATIONS TO ASSIST WITH THE PREPARATION OF
PLANS OF SUBDIVISION AND LAND/RESOURCE DEVELOPMENT PROPOSALS**

FIGURE 6
**WATERSHED AND
MUNICIPAL PLANNING**



Watershed planning and land use planning consider the same environmental issues, but from differing viewpoints and at different levels of detail. A land use planning decision for site-specific development can influence many watershed management and land use planning issues. The input of environmental objectives and management recommendations to the land use planning process at appropriate stages should promote informed decision making, which will in turn lead to greater efficiency and effectiveness of both processes.

It is important to understand the relationship and timing between watershed management studies and various stages of land use planning. This can establish which studies and what levels of detail are required to influence and support land use planning decisions. Broad planning policy documents such as Official Plans would benefit from including environmental policies and the community would benefit from implementing these. Ideally, the various levels of watershed studies should precede land use studies to provide early input to land use planning decisions.

It will not always be possible to prepare watershed plans for all watersheds. Watershed plans "set the stage" for the undertaking of smaller scale subwatershed management plans. A subwatershed plan should reflect the goals of the watershed plan, but is tailored to tributary needs and local issues. Subwatershed plans can provide more detailed guidance for site-specific water resource planning issues. Further detail on a more regionalized level of water resource planning can be found in a companion document, *Water Management on a Watershed Basis: Implementing an Ecosystem Approach*.

Watershed/subwatershed plans and land use plans need to be responsive to the recommendations, policies and directions of the other. Any conflicts or inconsistencies which arise between the two should be resolved at the earliest possible stage. Finally, any integration of watershed/subwatershed plans and land use planning must be flexible in order to respond to local situations throughout the province.

Municipalities have the legislative authority and political responsibility to undertake comprehensive land use planning which considers environmental issues. Subwatershed plans will not be determining land use; instead, these plans will establish constraints, opportunities and approaches for input into land use planning decisions. Further information on how water resource management and land use planning can be appropriately and genuinely integrated can be found in a companion document, *Integrating Water Management Objectives into Municipal Planning Documents*.

1.4 Environmental Assessment Principles

The subwatershed planning process may lead to recommendations for environmental management practices and Best Management Practices (BMPs) which include works or undertakings that are subject to the Environmental Assessment Act (EA Act). Projects which are subject to the EA Act must meet the requirements of the Act before any other provincial or municipal approvals for the project may be issued. For this reason, it is important to consider the potential applicability of the EA Act when carrying out subwatershed planning.

The intent of the EA Act is "to provide for the protection, conservation and wise management of the environment through planning and informed decision making." Successful planning under the EA Act

consists of five key features: consult with all affected parties; consider a reasonable range of "alternatives to" the undertaking and "alternative methods" of implementing it; consider all aspects of the environment; systematically evaluate the net environmental effects of each alternative considered; and provide clear, complete documentation.

If fundamental EA principles are incorporated into the subwatershed planning process, many of the EA Act requirements for specific projects could be met through the subwatershed plan. The information developed through this planning process could be subsequently built upon to satisfy outstanding EA requirements.

The requirements under the EA Act for projects resulting from subwatershed plans will vary depending on the proponent and the type of project(s). A particular project may require an individual environmental assessment or an approval may already exist if a Class Environmental Assessment (Class EA) is followed. Certain projects resulting from the subwatershed plan may be exempt from the EA Act. It is anticipated that the majority of projects resulting from subwatershed plans may be planned according to the procedures specified in existing Class EAs (e.g., Municipal Engineers Association, Class EA for Municipal Sewage and Water Projects; or The Association of Conservation Authorities of Ontario (CAAO) Class EA for Water Management Structures).

Proponents interested in harmonizing the subwatershed and EA planning processes should review the EA requirements for the types of projects that could be anticipated as a result of subwatershed planning. This will help to determine what specific EA requirements need to be incorporated into subwatershed planning.

2.0 SUBWATERSHED PLANS

2.1 Why do Subwatershed Planning?

Traditionally, planning for developing areas was based on parcels of land defined by jurisdictional boundaries or development proposals. Such limited planning responded only to the needs of the proposed development, and in many cases, was limited to subdivisions, resulting in a piecemeal approach which failed to capitalize on regional opportunities. Subwatershed planning, on the other hand, provides an opportunity to consider the carrying capacity and integrity of the ecosystem.

Environmental problems continue to be manifested in degraded watersheds, despite large expenditures of private and public funds for impact mitigation studies, urban planning, and servicing for new development. The ability of municipalities and the Province of Ontario to pay for current needs for the operation and maintenance of municipal services, e.g., sanitary and storm sewers, sewage treatment plants, flood control facilities, drinking water treatment, etc., and environmental cleanup activities is already exceeded.

The subwatershed planning process has incorporated a number of approaches that differ from traditional ones:

- P There is a shift from an approach of remediating existing environmental problems to a proactive approach that stresses protection and enhancement of the environment.
- P With emphasis on the protection of the form and function of the natural environment, it is no longer acceptable to impair water quality, degrade aquatic/terrestrial habitats, reduce baseflows, lower ground water tables or line watercourses with concrete to the point where the integrity of natural systems is lost.
- P Interactions and relationships of components of the natural environment are studied to improve knowledge of ecosystems.
- P The planning process incorporates consultation, early involvement and contributions from all affected parties, and the evaluation of environmental effects of proposed undertakings.
- P Finally, the multidisciplinary efforts carried out in subwatershed planning and the sharing of information throughout the process promote more effective planning for both land uses and the environment.

There are broad environmental and economic benefits of subwatershed planning. It considers water management and land use planning in terms of the whole ecosystem, specifically on the basis of a subwatershed, which crosses local government boundaries. It sets water-related objectives and targets to be considered before official plan documents are formulated and land use decisions made, or concurrently with these processes. These targets can then be formally incorporated into official plans or plan amendments and merged with land uses promoting economic growth and development.

"Why do subwatershed planning?" can be answered with the following list: **environmental protection/pollution prevention, better planning, guidance for infrastructure decisions and spending, streamlined approvals, major overall cost savings, especially remediation costs, local public involvement, agency credibility, enhanced economic viability of an area, and economic benefits of a clean environment.** In most cases, it should be possible to accommodate both development and ecosystem needs.

Environmental protection/pollution prevention. Watershed and subwatershed plans consider the whole ecosystem on the basis of a (sub)watershed, so the scope of what is taken into consideration provides a better "vision" for the local ecosystem so that environmental problems can be prevented. Loss of environmental resources and damage to natural systems often has seriously negative social and economic implications, e.g., ground water degradation necessitating increased municipal servicing needs and attendant costs. Ultimately, a failure to sustain natural ecosystems undermines the well being and property rights of all individuals.

Better planning. These are multi-agency exercises, involving conservation authorities, municipalities, local planning boards and provincial ministries, so that various agency objectives can all be accommodated for better planning.

Infrastructure guidance. A subwatershed plan can provide a context for more efficient servicing decisions and cost-effective capital expenditures.

Streamlined approvals. Since the interests of many agencies will have been incorporated into the plan, the process avoids problems in the provincial review and approval process such as: uncoordinated, inconsistent reviews of development plans, lengthy delays in approvals, narrow focus, emphasis on mitigation not prevention, no consideration of cumulative effects.

Savings. Costs are reduced for all participants by shorter approval time, lower capital expenditures for remediation and protection works and fewer staffing requirements. Interest savings on carrying costs can accrue for developers.

Public involvement. The public will have meaningful opportunities in this broad-based process to influence environmental protection and land uses in their communities.

Credibility of participating agencies. The public's credibility in the ability of government agencies and private industries not only to work together but also to meet society's demands for a healthy environment and economic growth will be enhanced.

Enhanced economic viability. Subwatershed planning, by promoting a clean healthy environment, also promotes long-term economic viability. For example, it considers water quality, supply and wise use, waste assimilation, efficient servicing, flood and erosion protection, ground water protection -- all qualities that are attractive to development and economic renewal efforts. Other spin-offs are recreation opportunities, tourism, urban fisheries. Also, since business benefits, more business is generated, e.g., i) developer knows what is needed in environmentally responsible servicing plans, ii) community gets better, more efficient, cheaper services, iii) climate attracts more economic development.

The Environmental Assessment Advisory Committee has supported integrated environmental and land use planning in a number of its reports on local planning and approvals. Specifically, the committee suggests identifying the long-term costs of traditional development practices (including subsequent remediation costs) to compare with preventive (sub)watershed planning, and advocates extending environmental protection from local significant areas/biota to overall ecosystems.

2.2 What is a Subwatershed Plan?

Subwatershed plans will recommend how water resources and related resource features are protected and enhanced to coincide with existing and changing land uses. As well, other major uses of water, outside the municipal planning process, need to be factored into land use decisions. These uses include withdrawals, channel alterations, diversions, etc., that are carried out under various pieces of legislation and the federal Fisheries Act. **Briefly, subwatershed plans allow water-related environmental objectives and targets to be set at a time when they can be effectively incorporated into land use planning documents.**

Specifically, subwatershed plans will:

- P Identify the location, areal extent, present status, significance and sensitivity of the existing natural environment within the subwatershed.** A complete range of environmental features and influences on natural systems must be addressed, including the

quantity and quality of surface water and ground water, aquatic and terrestrial habitat, fisheries and wildlife communities, soils and geomorphology, how they are linked and how these linkages are influenced by human activities.

- P **Establish goals and objectives for management of the subwatershed.** Where a watershed plan exists, it will provide watershed goals and objectives that must be recognized in subwatershed plans. Where no watershed plan exists, local and downstream uses/needs, e.g., swimming, drinking water supplies, must be addressed in the subwatershed goals and objectives.
- P **Identify environmentally sensitive or hazard lands, and recommend, with reasons, appropriate environmental management practices.**
- P **Identify lands where development may be permitted, provided it is designed to ensure that ecological functions are protected and maintained.**
- P **Provide directions for the screening and selection of Best Management Practices for the subwatershed.** Recommended practices should address a range of activities including agricultural, development servicing, aggregate extraction, woodlot management, retrofitting activities, water taking, etc.
- P **Address cumulative impacts of changes to subwatersheds on the natural environment,** and determine how existing and future land uses can compatibly exist with the natural environment.
- P **Integrate disciplines, policies, mandates and requirements of all agencies and interests** in a subwatershed to resolve conflicting or changing approaches to watershed management.
- P **Provide direction, consistency and uniformity of conditions of approval** for individual municipalities within the subwatershed.
- P **Promote public participation in and support for** subwatershed planning.
- P **Establish an implementation strategy** that identifies roles, responsibilities of all involved parties and timing of works and programs to ensure that chosen environmental and development practices are implemented.
- P **Outline requirements for monitoring programs and information updates as well as facilities recommended by the plan.**
- P **Provide technical information** that will assist in the development of Community Plans and the design of subdivisions.

The subwatershed plan should be a readable, concise document that presents methodology, assumptions, findings and recommendations. These plans are intended for wide readership and use by resource managers, elected officials, landowners and developers. Technical studies essential to

the development of the subwatershed plan should be provided in separate appendices. These appendices should provide all pertinent technical data and analyses in support of the recommendations of the subwatershed plan. Technical information in both the report and the appendices should be presented graphically wherever possible for easy interpretation.

Contents of a subwatershed plan are described in Table 1. The plans will provide a range of information and practical recommendations on boundaries, links to other planning/environmental tools, management objectives, and methods for implementation.

2.3 Subwatershed Plan Boundaries

There is no standard way of establishing subwatershed boundaries. Subwatershed plans are based on a tributary. Factors to be taken into consideration include:

- P** the location and extent of proposed development activities
- P** the existence and nature of sensitive downstream water-related natural features, uses, conditions or hazards
- P** available watershed plans specifying subwatersheds for study

TABLE 1

COMPONENTS OF A SUBWATERSHED PLAN

A Subwatershed Plan clearly presents the following information:

- P SUBWATERSHED BOUNDARIES** including rationale for their establishment.
- P RELATIONSHIP OF SUBWATERSHED PLAN** to watershed plans (if available), and to other urban drainage, environmental, land use and planning studies and programs.
- P IDENTIFICATION OF FORM AND FUNCTION OF NATURAL SYSTEMS** including land uses, natural features, linkages, and surface and ground water systems. Identification of existing systems should include aquatic and terrestrial features/habitats, and the quantity and quality of surface and ground water resources, relationships and water-related dependencies, and factors influencing the viability of the resources.
- P SUBWATERSHED OBJECTIVES** for public health, public safety, aquatic life, resource management, floodplain management, and urban, agricultural and other land uses.
- P PLAN RECOMMENDATIONS**
- specify areas for protection, rehabilitation and/or enhancement. It should be clearly noted where changes within the subwatershed should not occur, along with appropriate setbacks from natural areas, and recommended management strategies for these areas
 - establish areas that can be developed in a manner compatible with subwatershed objectives; identify how this can be achieved through use of best management practices and drainage system design that will protect, enhance and/or rehabilitate natural areas and systems
- P IMPLEMENTATION PLAN** outlining:
- policy/guidelines to direct development planning and design•
 - design, function, siting and timing of facilities•
 - funding of works, interagency review/approvals, and regulation requirements•
 - recommendations and responsibilities for future studies•
 - operation and maintenance responsibilities•
 - monitoring program and responsibilities•
 - approaches and responsibilities for information updating and corrective actions•
 - time frame for review/update of plan•

P an agreement on boundaries with the conservation authority, or provincial agencies where no conservation authority exists

P expansion of boundaries may be necessary to accommodate special features, e.g., adjacent woodlots, aquifer recharge areas

2.4 Multidisciplinary Plan Preparation

Subwatershed planning requires the input and expertise of a wide range of professional disciplines to comprehensively address planning, environmental and engineering issues. It will be important for the project coordinator to have a general understanding of resource protection and development issues and some expertise in managing a multidisciplinary team of technical experts. All those involved in the project need to work cooperatively throughout the life of the project so that:

P there is a good understanding of all natural systems including features, water-related processes and relationships of various components of the natural environment with human activities

P there is continuous, clear communication among all technical team members throughout the project

P integrated decision making occurs at appropriate points throughout the project

The development of integrated physical, chemical and biological profiles of a subwatershed will require the skills of a variety of professionals. In the majority of subwatershed plans, expertise will be required in the fields of hydrology, hydraulics, hydrogeology, geomorphology, aquatic and terrestrial ecology, engineering and planning. In a few unique subwatershed plans, this team of professionals may be augmented with specific expertise in wetland ecology or toxicology and/or other fields of specific environmental expertise. The degree of involvement required by each of the disciplines will vary from one study to another depending upon specific natural features and issues to be addressed. It is essential that all members of the project team have a clear understanding of all the issues to be addressed throughout the entire exercise of preparing the plan.

3.0 PLANNING FRAMEWORK

3.1 Overview

This section describes the steps which should be followed for organizing and managing the development of a subwatershed plan. Figure 7 shows the three main stages in this process and the key considerations in each stage.

FIGURE 7
PLANNING FRAMEWORK

SET THE STAGE

- recognize the need
- establish the issues
- establish the coordinating agency
- develop and seek support for funding proposal

.....
This stage will answer the following questions:

- Why is a study needed?
- Where in general will the study occur?
- Who will be coordinating agency?
- What issues need to be studied?
- What funding is required?

PREPARE THE PLAN

- select/appoint study coordinator
- formalize agency commitments
- define study area
- complete data base overview and tour subwatershed to define/refine issues
- develop preliminary goal statements for subwatershed
- prepare terms of reference
- establish steering committee and their function
- develop public involvement program
- collect/synthesize data base for study team
- monitor budget and schedule
- establish means of resolving disputes

.....
This stage will answer the following questions:

- Who will initiate the study?
- What are the studies terms of reference?
- What committees should be established and who should be involved?
- What are study boundaries?
- What role does the coordinator play in directing the study ?
- What are the issues and how are they addressed?
- How will the public be involved?

ADOPT THE PLAN

- review/modification of plan modifications
- obtain agency endorsements and acceptance of implementation schedule

.....
This stage will answer the following questions:

- How can agency commitment be obtained to ensure that plan is implemented?
- How will individual agencies accept the plan?
- Will the public support the plans?

This framework is intended to assist coordinating agencies, and especially the project coordinator. It provides information on why and how these studies are started, what issues are to be addressed, and the timing of various activities. This section incorporates, where possible, the lessons to be learned from previous projects, identifying potential problems and solutions.

The three stages in plan development are:

- P Set the Stage
- P Prepare the Plan
- P Adopt the Plan

3.2 Set the Stage

In the more rapidly urbanizing watersheds of southern Ontario, staff of conservation authorities and municipalities are facing daily pressures to provide answers on agency information needs and study requirements, and to provide input into the review and approval of development plans. In these areas, development pressures can generate concerns for the protection and management of the natural environment. Local governments largely welcome and promote land development, and conservation authorities and provincial agencies have mandates to protect and enhance the local environment. The Regional Municipality of Waterloo was one of the first municipalities to recognize that subwatershed/watershed planning is an effective way of accommodating the apparently conflicting demands of environmental protection and urban development/land uses.

Either a watershed plan, if there is one, or an Official Plan may endorse and/or recommend the development of a subwatershed plan. In the latter case, the Official Plan should clearly identify the need for subwatershed plans to be developed in support of proposals for land use change.

At this stage, a number of actions can be taken to establish the framework for developing the subwatershed plan.

- P Establish and secure agreement among stakeholders on the need** for a subwatershed plan. Obtain commitments from parties and agencies for participation, support, adoption and implementation of the plan.

- P Identify the main issues or concerns** in the subwatershed. Although key issues may not always be immediately apparent, the general character of the subwatershed area will be known in most cases. An overview report may be helpful in focusing this information. It may include the presence, features and status of:
 - watercourses and valleys (channels, buffers)
 - downstream flooding and/or erosion problems/hazards
 - water quality
 - fisheries potential (cold or warm water)
 - wetlands
 - Environmentally Significant Areas or Areas of Natural or Scientific Interest
 - woodlots

- recreation opportunities
- agricultural land uses
- land development proposals
- water-takings, water uses, water conservation
- ground water recharge/discharge areas, baseflows
- municipal servicing needs

This ability to document the main features of the watershed is useful during the early discussions of the subwatershed plan. One should not be concerned, at this point, with overlooking issues or concerns in the study area which may prove important at a later stage. These issues will be more firmly established during subsequent stages of plan development.

P **Establish the appropriate coordinating agency.** The local conservation authority is generally the agency most suitable for coordinating the preparation of a subwatershed plan, particularly where the subwatershed crosses municipal boundaries. An upper tier (regional) municipality or, in the case of a small subwatershed, totally contained within its boundaries, a local municipality may undertake coordination. In municipally unorganized areas, and in areas outside of conservation authority jurisdiction, MNR and MOEE may take a lead role.

P **Determine funding responsibilities.** All parties should establish the extent of funding that will likely be required, the extent to which each party could contribute, and possibilities for phasing the undertaking. The phasing of subwatershed plan development may allow for cooperative sharing of costs among government agencies and the development community by spreading fiscal demands more comfortably over time. It also allows for prioritizing issues needing attention, and thus, for better estimation of costs.

3.3 Prepare the Plan

A number of actions are needed to successfully launch and propel the plan's development. Among these are the establishment of a Steering Committee, and the formalization of the Terms of Reference. Following are some key actions:

- P** **Select a qualified project coordinator.** This is a key factor for ensuring the success of the subwatershed planning process. Critical strengths of the position are:
- **A basic understanding of the issues.**
 - **Multi-agency perspective.** Each agency's mandate and issues of concern should be understood.

- **Effective leadership and communication** skills are needed for the coordinating role of linking technical experts, planners, stakeholders and the public.
- **Ability to anticipate and resolve conflicts.**
- **Project management** skills to ensure that budgets and schedules are maintained.
- **Agency support**, i.e., time and resources to do the job.
- **Ability to facilitate timely input** from the public and non-government organizations.

P **Establish a Steering Committee.** For best results, as demonstrated in previous watershed planning efforts, the Steering Committee should be small, say, 6 to 12 people, and should consist of representatives from the core agencies, including both lower and upper tiers of affected municipalities, the local conservation authority, and the Ministry of Natural Resources and the Ministry of Environment and Energy. Other agencies, developers and/or members of public interest groups may also be appropriate participants on the Steering Committee, and, on the basis of their mandates, may become involved at certain decision points.

Municipal planning and public works departments should both be represented by senior level staff; representatives of departments such as parks, recreation, engineering and environment could also play a part as appropriate.

Steering Committee members should:

- effectively represent their organization
- have the authority to commit to the plan
- be willing to negotiate to resolve conflicts
- commit time and effort where required to meet deadlines

P **Confirm boundaries.** The project coordinator, in consultation with the Steering Committee, should confirm or redefine previously identified boundaries of the subwatershed.

P **Complete/Expand the Data Base Overview.** A key step in beginning the plan development process is a review of existing data. The project coordinator should expand the initial subwatershed overview with relevant resource information from other involved agencies. This does not have to be an exhaustive inventory of data, but rather an assembly of some of the most relevant information. Examples, with sources, of this information are:

Ministry of Environment and Energy - air, surface and ground water quality, existing and proposed landfill sites, past/present studies, sewage treatment plants best management practices

Ministry of Natural Resources - floodplain management fisheries, wildlife, wetlands, Areas of Natural and Scientific Interest (ANSIs), provincial parks, Crown lands, forest and aggregate resources, unstable slopes, geological maps

Local Municipality - proposed development plans showing limits of development; regional and local environmental, ground water studies, existing environmental provisions, transportation and servicing infrastructure

Regional Municipality - regional/county knowledge of ground water, transportation, infrastructure, Environmentally Sensitive Areas (ESAs)

Ministry of Transportation (Ontario) - provincial roads, existing and proposed drainage systems

Management Board Secretariat - government lands, proposed land uses

Ministry of Northern Development and Mines - mines, mine tailings ponds, development areas, geological maps

Ministry of Culture, Tourism and Recreation - natural/cultural heritage areas

Ministry of Housing (Regional Housing Programs Offices) - housing policy statements and objectives for local areas

Ministry of Agriculture and Food - significant farm lands, municipal drains, land stewardship projects, soils reports, agricultural land use mapping

Conservation Authority - Environmentally Significant Area designations, erosion site inventories, flood and fill line designations, shoreline management, existing master drainage plans, watershed plans, conservation areas

Universities and Community Colleges - special studies, technical expertise, research or masters thesis

Special Interest Groups - specific reports or inventories, e.g., Federation of Ontario Naturalists, Ontario Federation of Anglers and Hunters, Ducks Unlimited, Trout Unlimited, Conservation Council of Ontario

P Tour of Subwatershed. Tours can provide field verification of the existing knowledge base, clarification of various issues, and identification of areas of special concern.

P Develop Goal Statements. Through the perspective gained by touring the subwatershed, and knowledge of the key resource features, the project coordinator should develop a set of statements for the subwatershed. Goal statements should be simple and measurable.

P Terms of Reference. The Terms of Reference will clearly identify the work program, the project schedule and the **expected product**. Terms of References for watershed/subwatershed studies have been prepared for a number of projects in southern Ontario.

P Steering Committee Study Startup Meeting. At this point, there will already be identified a draft study area boundary on established knowledge base, key subwatershed issues, a preliminary set of goal and objective statements for the study area, study budget needs, and draft Terms of Reference. The Steering Committee must reach agreement on each of these items at this stage, prior to presentation to other interest groups and the public.

P Define Data Requirements.

- Not all studies have to be "cadillac," big-dollar studies.
- The information needed to conduct the study and to develop planning methodologies will be established in consultation with the public and agencies.

P Start Public Involvement. The project coordinator and Steering Committee members should determine key public interest groups in the subwatershed, including ratepayers groups, naturalists clubs, sporting groups and others. The early and continued involvement of the public is one of the most important tools for achieving the support needed to develop and implement the plan. The project coordinator should carefully consider how and when the public should be involved in this process. (See Section 6.0)

P Funding Alternatives and Budget Needs. Funding support for development of the plan should already be established by this point. The project coordinator should define the specific budget needs, identify potential partners, and negotiations should begin to secure project funding for implementing the plan.

3.4 Adopt the Plan

When all stakeholders agree on a final direction -- a plan -- the coordinating agency works with participating agencies to coordinate implementation of the plan. The questions of affordability, cost/benefit and potential negative consequences of the measures proposed in a subwatershed plan would have been reviewed and agreed to by this point.

In large measure, the ease with which the plan is adopted will depend on the effectiveness of the preceding stages in the process of developing it. The responsibilities for implementation and the provision of operating costs now fall to participating agencies.

It is useful for agencies involved in the development of the plan to be apprised of the progress of its implementation at key points. This indicates to those contributing time and money to the project that

it is coming to fruition, and also provides information to interested parties who may wish to undertake such an endeavour.

4.0 TECHNICAL ASSESSMENT

4.1 Overview

The technical studies in support of subwatershed plans should be flexible, cooperative and practical in order to successfully integrate watershed management and land use planning. Typically, a team of experts undertakes technical work on behalf of the Steering Committee. Here are some key features of this work:

Flexible - Each subwatershed study needs to be tailored to specific subwatershed issues and local municipal concerns. It should also recognize the status and recommendations of watershed plans where available.

Multidisciplinary - These studies require environmental, planning and engineering expertise to provide analysis of a wide range of environmental issues and development options.

Integrated - An understanding of all components of natural and man-made environments affecting the integrity of natural systems is a critical component of these studies.

Time Saving - Subwatershed plans can reduce the time spent on site-specific plans, e.g., stormwater management, review and approval processes, by providing a "blueprint" of requirements for all subsequent works. In this way, the number of small site-specific plans can be reduced and addressed for refocusing, and duplication of effort avoided.

4.2 Staging Plan Development

It has been suggested that the best way to integrate technical components of the plan with land use planning decisions is to carry out plan development in stages, or phases, so that the plan unfolds consistently and in conformity with real conditions, as more information is gained from technical assessments, and can be incorporated into key decision points or mechanisms in the land use planning process. This approach is not intended to lengthen the time frame of plan development, but rather to enable participants to collectively make decisions about the subwatershed at key points throughout the evolution of the plan. It can also enable some studies or activities to be undertaken when complete funding and/or support is not immediately available.

This document discusses a two-phased approach. However, more phases could be added in order to respond to local concerns and needs. In some situations, for example, because of

resource limitations, an initial phase could be simply the gathering of background data, and establishment and preparation of terms of reference.

Phase 1 will:

- P outline the location, extent, sensitivity and significance of all components of the natural systems
- P identify land/water linkages and processes
- P identify factors and influences that are important to the integrity of various existing or desired components of the environment
- P identify watershed and subwatershed goals, objectives and targets
- P identify opportunities for protection, enhancement, rehabilitation and development
- P identify monitoring needs
- P identify plan review and update schedules

The complexity of Phase 1 work depends on whether watershed plans or other relevant environmental planning studies have been completed. For example, watershed and subwatershed objectives and targets may already be established; information on natural features to be protected may already exist in environmental or greenspace planning studies. Phase 1 of a subwatershed plan should incorporate or complement, not duplicate previous relevant work. If no previous studies are available, some aspects of the watershed plan could be done as part of Phase 1 activities.

Phase 2 will develop a plan that will recommend:

- P areas to be protected, enhanced and rehabilitated
- P various types/intensities of proposed development
- P management practices for open space areas
- P best management practices and designs for the management of the quantity and quality of surface water and ground water
- P an implementation strategy to guide development, those responsible for designing and building recommended works at what time, and responsibilities and requirements for cost-sharing, future studies, monitoring and maintenance

Major activities in Phases 1 and 2 are outlined in the following sections; Figures 8 and 9 show the suggested activities in each phase.

4.3 Phase 1

4.3.1 Steering Committee Direction

The Steering Committee will convene at the outset of the process to discuss:

- P specific concerns and interests in the subwatershed
- P available and needed data base
- P land use assumptions within the subwatershed for hydrologic analysis
- P confirmation of subwatershed boundaries
- P municipal servicing needs, expectations and priorities
- P subwatershed resource management objectives, tailored to suit individual subwatershed conditions

FIGURE 8 PHASE 1 ACTIVITIES

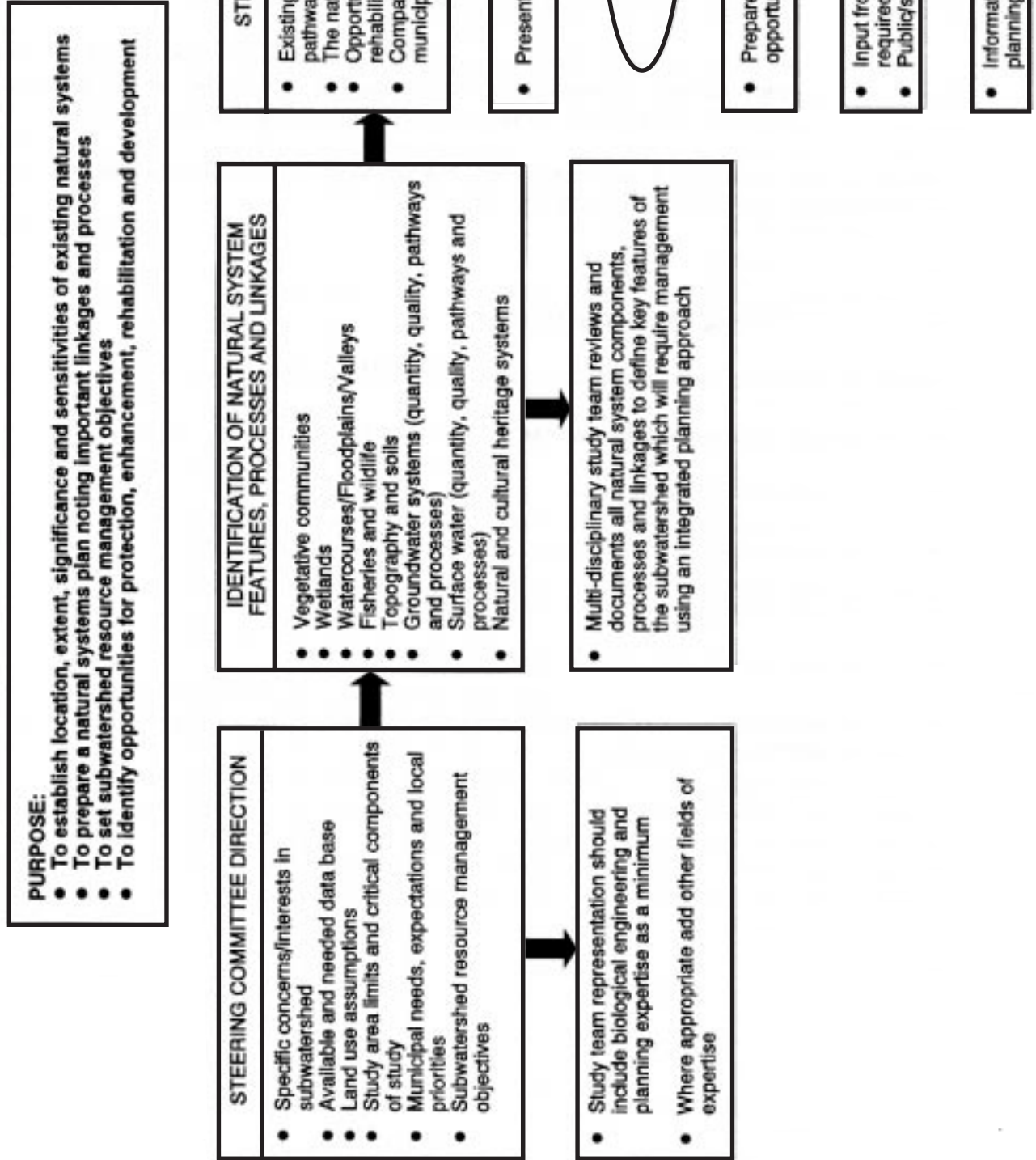
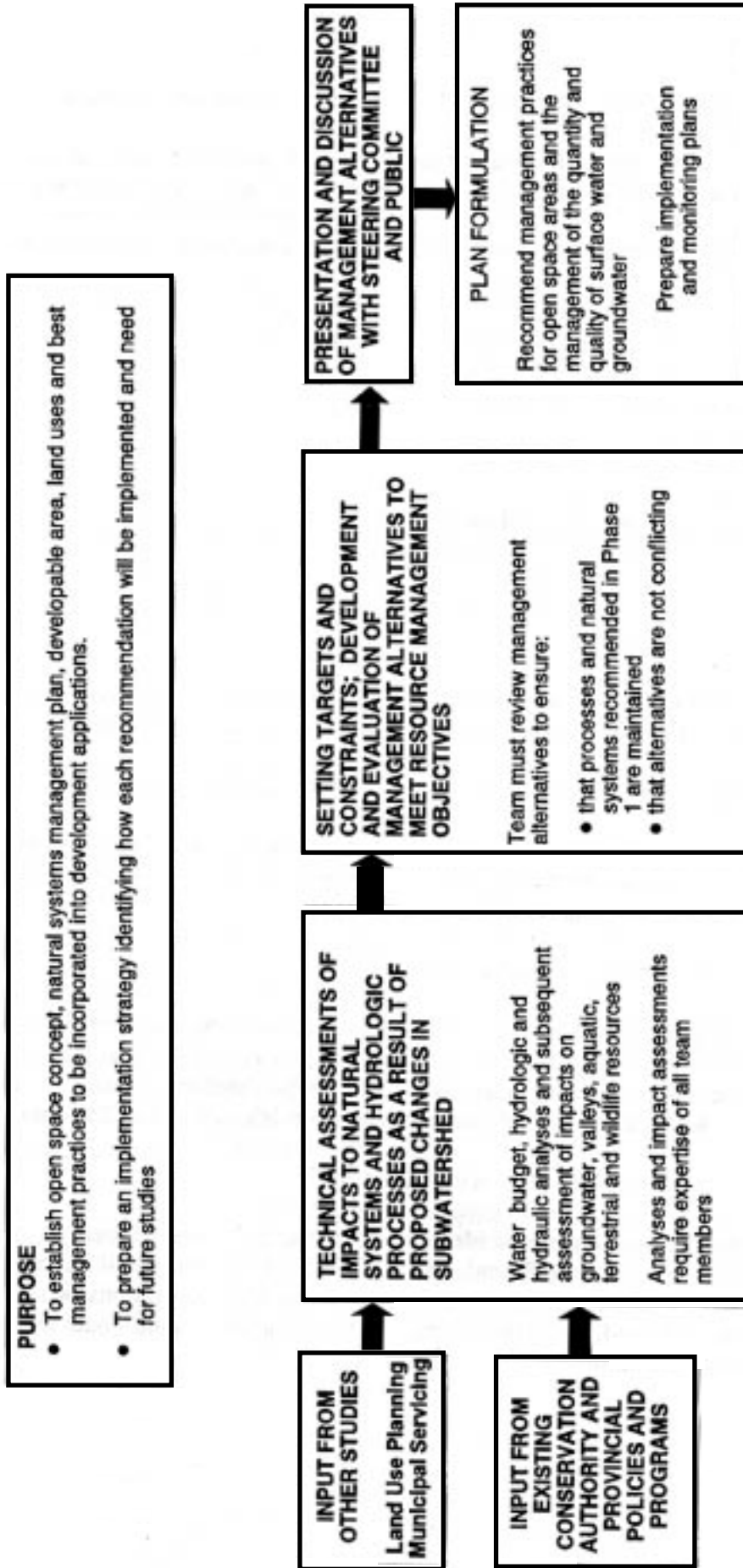


FIGURE 9 PHASE 2 ACTIVITIES



4.3.2 Identification of Natural Features, Processes and Linkages

The existing data base should be augmented with field data and inventories where necessary to identify existing natural features, existing hydrologic processes, functions and physical linkages. At this stage, a Natural Systems Plan can be prepared that presents a map of the following features, and explains their water-related dependencies and their relationship to human activities. Key features include:

- aquatic and terrestrial ecology
- wetlands
- watercourses/valleys/floodplains
- stream geomorphology
- fisheries, wildlife and habitats
- topography and soils
- ground water (quantity and quality)
- surface water (quantity and quality)
- natural and cultural heritage systems

4.3.3 Steering Committee Input

Once the study team has a good understanding of the natural systems within the subwatershed, the team should discuss the following issues with the Steering Committee:

- P existing natural features, processes and water-related linkages
- P opportunities for protection, enhancement, rehabilitation and development (integration of resources management objectives and municipal needs/priorities with existing natural features, processes and linkages)

4.3.4 Public Review and Input

At this stage in plan development, it is important to advise the public of plan progress to date, and to obtain public comment on resource management objectives, and identified opportunities for environmental protection, enhancement and rehabilitation, as well as compatible land development. More discussion of public consultation is contained in Section 6.0

4.3.5 Identify Subwatershed Opportunities

At this point, opportunities can be identified for protection, enhancement and rehabilitation of natural features and processes, for enhanced hydrologic functions, wildlife habitat and for human recreation, as well as compatible land development. The implications of these opportunities should also be identified. All opportunities and implications should be reviewed and endorsed by the Steering Committee.

4.3.6 Other Land Use and Servicing Studies

The findings of Phase 1 on natural features and opportunities in the subwatershed should be made available to land use planning and municipal servicing studies that may be underway. In return, planners and engineers working on technical aspects of the subwatershed plan should know about planned road locations and municipal services. In this way, possible conflicts can be minimized between the need for infrastructure and the need for environmental protection. Also, for this same reason, Phase 1 work should precede servicing studies and land use planning work; doing so can decrease costs and improve efficiency.

4.4 Phase 2

4.4.1 Input from Other Studies

Information from other land use and municipal servicing studies will be used in technical analyses done in this phase. This information includes:

- P preliminary land use and road layout information for hydrologic and water budget analyses
- P preliminary locations of municipal services including road crossings of valleys, sanitary sewers alignment or any other services proposed in open space areas
- P utility information, e.g., hydro or gas easements, crossings

4.4.2 Technical Assessment of Natural Systems and Hydrologic Processes

The technical assessment will establish how natural systems and hydrologic processes will respond to proposed changes in land use in the subwatershed.

This work will require water budget analyses to be carried out in addition to traditional drainage analyses done in flood mapping. Traditional analyses tended to focus all attention and efforts on the simulation of surface runoff estimates for the subsequent design and management of surface drainage systems, and were based on infrequent, design-based rainfall events. This approach has not adequately considered other components of the hydrologic cycle including infiltration, evapotranspiration and ground water recharge.

These more comprehensive studies require that all components of the hydrologic cycle be analyzed and more attention be given to frequent rainfall events and to the protection of ecosystem function. Accordingly, water budget assessments must be carried out for existing and future conditions in subwatersheds, including estimates of changes to the quantity of surface water and ground water and analyses of water quality changes.

4.4.3 Setting Targets and Constraints

Technical assessments provide information on potential hazards and impacts to natural systems if land development and urban drainage are not managed properly. This information can be used to establish targets and constraints that are subsequently used for evaluating how well the subwatershed plan meets watershed plan objectives. Examples are as follows:

- P** Results of flood analyses may identify flood-susceptible structures and how uncontrolled surface runoff would increase the flood susceptibility of the structure. This information can be used to establish the level of quantity that control must be provided.

- P** Technical assessments might indicate that certain valleys are sensitive habitats, and can be considered a constraint for the location of water management features such as ponds or outfalls.

- P** Wetland assessment might indicate that certain wetlands are sensitive to changes in the water table.

4.4.4 Developing Subwatershed Management Alternatives

With a list of targets in hand, the technical team should develop alternative plans in accordance with subwatershed resource management objectives. Alternatives might include a variety of best management practices, drainage patterns, land uses, development planning controls, mitigative works, enhancement/rehabilitation programs, etc. It is important that the alternatives developed in this exercise are not directly in conflict with each other.

4.4.5 Evaluating Alternatives

Suggested alternatives for managing the subwatershed should be evaluated on the basis of a set of criteria developed for the subwatershed. Evaluation criteria must recognize the need to meet watershed goals and objectives, as well as cost, ease of implementation, maintenance needs, safety and aesthetics. Alternatives should be presented to the Steering Committee and the public at this stage for comments.

4.4.6 Finalizing the Subwatershed Plan

Finally, on the basis of all the information and comments gathered, a preferred subwatershed plan is drafted. The plan includes mapping of areas of preferred land uses and those for which certain practices or structures are proposed. The final step in plan development is review and adoption by all agencies and the public.

5.0 INFORMATION NEEDS

In identifying information needs for subwatershed studies, participants need to establish the techniques and approaches to be used to prepare the plan. A clear understanding is needed of the issues the plan will address and the kinds of recommendations that will be forthcoming from the plan. What information do you need to know, to make decisions or to prepare your plan?

Information is expensive, not only to collect, but also to analyze. There are no magic rules to assist the planning team in determining the type or amount of information a subwatershed plan will need. Studies underway or recently completed subwatershed plans may provide some direction for gathering information relevant to the topics listed below. However, some protocols for screening and assessing the information are needed in order to focus the assembly of information on the needs of the plan.

- Drainage systems and patterns
- Geomorphology
- Geology and soils
- Aggregate resources
- Hydrogeology
- Water quality trends
- Agricultural practices
- Fish and wildlife
- Storm water management facilities
- Flooding trends
- Infrastructure and services
- Housing needs
- Erosion sites
- Waste disposal sites
(active, proposed, closed)
- Existing and proposed land use
- Planning designations
- Recreational uses
- Transportation corridors
- Water use/taking/conservation
- Discharge/recharge areas
- Precipitation/climate patterns
- Baseflow/flow records
- Riparian vegetation/woodlots
- Wetlands
- Hazard lands
- Pollution sources (point, non-point)
- Channel alterations
- Environmentally Significant Areas/
Areas of Scientific and Natural Interest

It is useful to organize and present existing data bases on appropriate scale mapping for the subwatershed. A suggested approach for overview mapping is provided in Table 2. For most studies, Ontario Base Mapping at scales of 1:10,000 or 1:20,000 would be appropriate. This mapping is available in digital and paper formats from the Ministry of Natural Resources. In all cases, the accuracy of information being mapped should be verified through field inspections.

- P the display of natural features and resource management strategies
- P drainage system design and mapping
- P determination of hydrologic/hydraulic parameters for modelling assessments based on soil mapping, land use patterns and terrain features
- P screening and site selection for Best Management Practises
- P system operations for Best Management Practices
- P floodplain management; hydrologic and hydraulic database linkages
- P ground water resource mapping

There will be circumstances when the planning team has no option but to undertake expensive technical studies to evaluate sensitive land use interactions with, for example, the hydrogeology functions of the subwatershed.

Information generated by special investigations should be shared with colleagues by the professionals gathering it. That is to say, where the findings from these studies have generic applications, they should be brought to the attention of neighbouring conservation authorities and municipalities.

In the case of hydrogeology studies, early input into planning the layout of new subdivisions may proactively address reasonable use concerns by separating incompatible land use practices and sensitive ground water uses. For example, Implementation Guidelines for the Oak Ridges Moraine Area, MNR, 1991, recommends that development be confined to areas with full municipal services and that expansion not be permitted until available serving is fully allocated; scattered development beyond the settled areas on the moraine would be discouraged. Development of settlements in rural areas will be based on municipally controlled communal water and sewage systems, which should minimize the need for ground water interference studies associated with septic systems.

It is clear that subwatershed plans need to switch from a narrow "single issue" perspective to systematic and multidisciplinary information gathering and interpretation. The challenge for the technical team is to identify information which will get at the root of the problems associated with current practices in "developing" watersheds, rather than just looking at mitigative measures. In this regard, the technical team should establish protocols for interpreting and applying the information generated, in order to fully benefit from a comprehensive, multidisciplinary understanding of the subwatershed, and to develop the best management plan for it. Also, this kind of prudent "focusing" of information is particularly important for controlling the cost of information.

Some considerations for establishing information needs are the following:

- P Focus on collecting information that will identify opportunities or solutions, rather than just problems.

- P Determine whether any missing information is essential for preparing the subwatershed plan.
- P Determine if information needs can be cross-referenced with watershed and subdivision plans.
- P Assess the possibility of developing or better coordinating the gathering of information to improve the efforts of the technical team.
- P Determine what information was important in successful plans and learn about pitfalls in less successful efforts.

6.0 PUBLIC PARTICIPATION

The purpose of public participation in any planning or decision-making process is to allow for an exchange of ideas between the planning team and the stakeholders so that controversy can be minimized or avoided, and knowledge upon which good decisions are made can be improved. Public education and participation in decision making are often viewed as luxuries that can only be undertaken if staff time and budgets permit. Increasingly, provincial and municipal agencies are recognizing that public participation in the development of plans or projects affecting the public is a key determinant of the success of these undertakings.

The real value of having the public play a part in planning something like subwatershed management is often overlooked. Interest groups and the public at large can provide valuable insights and information to any planning team, often bringing new ideas and a sound understanding of local conditions and aspirations. Drawing people into the planning process at an early stage can raise their concerns throughout the process, and can provide "checks and balances" to the planning professionals.

There is no single formula for designing an effective public education and participation program, but several key elements of any successful public participation strategy should be considered. If a rule exists, it is this: **a public education and participation strategy should be developed early as an integral part of the subwatershed planning process.**

There are many simple ways to reach the public and gather their concerns and insights.

- P **Printed materials**, such as brochures, flyers, fact sheets and newsletters are effective ways of informing people about the subwatershed planning process.
- P **Displays** at local shopping malls, fairs, or public meetings are an excellent method of educating the public and generating "feedback" on a one-to-one basis.
- P **Field trips** can be very effective in illustrating subwatershed issues to an interested public.
- P **Public meetings** are important ways of generating public discussion and even debate about key watershed issues; adequate advance notice is required as well as a broad enough scope of stakeholders.

P **Public opinion polling** is a fairly successful method used in the U.S. for gathering public attitudes about water management issues.

There are other benefits to both the public and to planning agencies from having the general public take part in developing water management plans. For agencies, having the public "buying-in" to a project is invaluable. Local support is generated, and political endorsement of the plan is likely to be easier if the public is in agreement with it and its goals. Also, a supportive public can assist in making the plan a reality and a success, by monitoring its implementation, its effects on local conditions, and its success in achieving the stated objectives.

Without public support and endorsement, many of the best-planned and engineered projects can founder in limbo, face stringent criticism and opposition, implemented poorly, or never be implemented at all. Countless examples over recent years demonstrate the importance of "buy-in" from the public. The Great Lakes Remedial Action Plan process has public involvement as an integral part of every stage of RAP development. Public Advisory Committees made up of local stakeholders participate in identifying the problems, developing feasible solutions, and assigning and accepting responsibility for actions and funding.

Moreover, the public in general has become much more knowledgeable and concerned about the environment, especially over the last five years or so, and with this awareness is a need for the public to feel that they are part of the solutions to environmental problems, as well as that they have a say in preventing new ones. Finally, since the subwatershed can be considered a "manageable" area for broad-based local participation in the planning process, the subwatershed plan can become a kind of "community plan," and the public become planners of their own local future.

7.0 MONITORING PROGRAMS

A subwatershed plan cannot be considered complete until its monitoring program is established. Monitoring programs should be designed to assess environmental changes in the subwatershed, to evaluate compliance with the plan's goals and objectives, and to provide information which will assist custodians of the plan to implement and update it. The monitoring program should be presented as part of the subwatershed implementation plan.

Monitoring is intended to ascertain whether the environmental responses to land use changes in the subwatershed are consistent with the subwatershed plan's goals and objectives, that is, what the plan expected or intended to occur in the environment.

Custodians of the subwatershed plan have the responsibility for undertaking the monitoring program and ensuring that the information generated is used effectively. A multidisciplinary team will be required to establish an appropriate monitoring program for the subwatershed and to advise the plan's custodians of how to carry it out and how to interpret and apply the findings. Successful monitoring programs have used protocols for inter-agency transfer of information and results have been incorporated into updates of regulations, bylaws and maintenance schedules.

Monitoring programs must be practical and cost-effective to be funded in the first place or to accommodate budget constraints over the life of the plan. Monitoring programs must also be simple and verifiable, so they are little affected by staff changes.

Effective monitoring programs do not have to include extensive field studies or exhaustive laboratory scans for pollutants. Field inspections by experienced staff can be used effectively to identify whether or not the plan is working, e.g., stream banks are stable and well vegetated, trout are being caught, the beach downstream of the subwatershed remains open. An added advantage is that these staff surveys are more likely to get done, and their findings are more readily interpreted.

Monitoring programs for subwatershed plans have to consider the rate and pattern of development within the subwatershed. For example, high growth scenarios experienced in rapidly expanding urban centres will require different environmental response monitoring strategies than those for subwatersheds where the level of development is not only smaller, but spread over a much longer period of time.

It is recommended that monitoring programs be designed to make comparisons with the conclusions from external studies instead of repeating them. Most importantly, subwatershed monitoring programs should not be viewed as an opportunity to fill in data gaps. Information gathering exercises for the subwatershed should be considered to be part of the technical studies necessary for the development of the plan.

Subwatershed monitoring programs should be carried out at several levels. For example, operational monitoring would audit the users of the plan to ensure that the plan is being implemented in accordance with the recommendations. A second level of monitoring might determine the health of the subwatershed by carrying out comparisons studies relative to baseline information generated or documented in the plan. Specific requirements to monitor management practices supported, but not controlled by subwatershed plans should be deferred to either higher (watershed studies) or lower (subdivision) level plans which oversee these practices.

When subwatershed monitoring programs are being designed, consideration should be given to parameters which will act as barometers of watershed integrity, in the same way as ailing canaries served as warnings to miners that dangerous gases were present. If best use is made of monitoring information accumulated on environmental responses to land uses/changes, our understanding of ecosystems at work and our ability to accommodate land use change will grow accordingly.

8.0 FUNDING

Subwatershed plans vary widely in scope and kinds of activities required, and many jurisdictions and agencies are likely to be involved in this work. Thus, there cannot be a simple, generic funding formula in place. Those participating in plan development and implementation need to be innovative in securing new and various funding sources and in properly scoping the nature, timing and extent of the work involved.

Funding support for the many subwatershed planning initiatives completed or begun over the last two or three years has come from local and regional municipalities (directly or through conservation authority levy), developers and provincial agencies (MNR transfer payments to CAs). The relative contributions of the partners varies widely on the basis of local circumstances. A principal factor influencing private sector funding participation has been the presence of major development interests and pressure for development approvals.

A well-designed approach to planning at the subwatershed level should allow cost savings for the development community that can be used for subsequent studies associated with individual development proposals, such as plans of subdivision, stormwater management plans and erosion management plans. This is achieved through the improved understanding of priority issues, the identification of environmentally sensitive areas and areas preferred for development, and the broader and interconnected view of servicing needs arising out of the subwatershed plan.

Participants may also find that some of their ongoing work can be "reprofiled" to contribute to the needs of the subwatershed plan. For example, in areas where a significant portion of the subwatershed is already extensively developed, spending on remediation and redevelopment planning could be combined with planning efforts focusing on the developing areas. Participants are encouraged to make study costs "affordable" by a realistic scoping of study needs, phasing plan development, sharing available information and drawing on experience from other subwatersheds.

9.0 SUBWATERSHED PLANS: BALANCED BENEFITS

Subwatershed plans, by their very nature, require a wide range of activities and disciplines to be integrated in to a broad, solid environmental and economic picture of the subwatershed planning area. This scope is, therefore, much wider, not only in geographic area but also in technical complexity, than master drainage planning. For that reason, subwatershed planning provides a much better environmental basis for land use decisions, since more factors, changes and responses are considered.

What is important is that the plan provides a range of practical, environmentally acceptable and economically sound **publicly valued deliverables**. These "deliverables" are the products of the plan that form the crux of its usefulness to all stakeholders and its benefit to the natural environment. For example, at the outset of planning for a number of subwatersheds, the importance of developing various plans could be ranked in priority for early attention, based on an evaluation system that takes into account the following factors which can become "deliverables" or benefits:

- significance and sensitivity of natural resources
- pressures for new development
- recreational opportunities
- water taking/water use assessment
- hazard lands - flooding, erosion
- efficient servicing
- limiting "urban sprawl"

Not only are such products valued by the public, they also serve to advance the mandates of various provincial and municipal agencies. The agencies, for their part, can accomplish this in a relatively cost-effective manner by such means as focusing their efforts, carrying out activities in phases, and funding these initiatives through partnerships with other agencies which also stand to benefit. Over the long term, their mandates can be fulfilled more effectively by devoting much of their efforts and funds to activities that will prevent problems in the future, thus saving more expensive costs for remedial actions that otherwise may be required later.

There is a further benefit to cost-effective preventative activities undertaken as part of a subwatershed plan. Streamlining the efforts and costs required to achieve the "deliverables" can shorten time required for approvals, which is itself a cost benefit, because the plan outlines agency requirements, encourages public input and concurrence, and addresses downstream issues. It follows that if this cost benefit is demonstrated in a number of subwatershed plans, then subsequent proposed plans are more likely to secure early commitments for funding.

Ultimately, subwatershed plans can form a solid foundation for regional economic development in the province. A sound subwatershed plan can encourage and attract new development because the time required for the development will be streamlined by virtue of many planning issues having already been resolved. New development, in turn, together with a healthy environment that is protected and preserved in greenspace and parkland and woodlot, promotes the growth and economic stability of the community.

Finally, the forward thinking, the balance of natural and economic interests, and the attainment of publicly valued products that are all prescribed in the subwatershed plan foster sustainable development at a local scale, where the whole community can enjoy its benefits.