GREAT LAKES SHORELINE MANAGEMENT IN ONTARIO

Patrick L. Lawrence
Department of Geography
University of Waterloo
Waterloo, Ontario N2L 3G1

The Great Lakes shoreline is characterized by a diversity of natural ecosystems ranging from low-lying rock shores, eroding glacial till bluffs, and sandy barrier beaches and under intensive pressure from human development and land uses. Existing shoreline management, planning policies and programs have focused on attempts to reduce property damages from severe flooding and erosion caused by high water levels. Shoreline management plans completed by Ontario Conservation Authorities focus on the physical conditions leading to flooding and erosion and a range of attempts to modify the hazard by the use of shore protection structures. This single issue approach fails to recognize the complexity of the Great Lakes shoreline and the issues and concerns that need to be addressed in a comprehensive coastal management program. Shoreline hazards are a function of human use and adaptation to the shoreline and should not be managed separately from land use and broader environmental concerns such as water quality, habitat loss and ecosystem health. With the current focus on land use planning reform in Ontario and the work of the Toronto Waterfront Regeneration Trust, there is an opportunity to consider improved mechanisms for decision making and management to reflect the growing international interest in integrated coastal zone management. A framework for Great Lakes coastal management is highlighted which would include developing a strategic vision, provisions for linkage of existing provincial legislation and policy, an improved method of resource inventory and environmental monitoring, and public education and communication.

INTRODUCTION

The development of coastal management policies reflects a shift in planning for the impact of human activities towards an increasing awareness of environmental issues. Coastal management historically has been seen as a government program established for the purpose of utilizing or conserving coastal resources (Ditton et al. 1977). Management and planning of the coastal zone can be considered a recent phenomenon, with most initiatives formed in the past twenty years. Unfortunately many of these efforts have been piecemeal with uncoordinated efforts of both the public and private sectors. In the last few years, there has been a trend away from the traditional hazards approach of management of coastal land uses and development to comprehensive planning based on principles of environment impact assessment, conservation of resources, ecosystem health and sustainable development (Sorenson et al. 1984).

With the United Nations Earth Summit in 1992 and Agenda 21, a range of international programs have been developed to promote and support integrated coastal zone management (ICZM) which reflects the diversity and complexity of human activities, environmental concerns and planning arrangements characterizing many coastal, marine and shoreline ecosystems. The objectives of ICZM are the strengthening of sectoral management, preservation and protection of productivity and biodiversity, and the promotion of sustainable resource use (OECD 1993). Coastal nations, stimulated by international interest and program development, are currently developing ICZM policies in response to ecosystem degradation, increased population and intensive land uses in the coastal zone, and concern for climate

change, sea level rise, storm activity, and associated hazards.

The recent interest in Great Lakes shoreline management is the result of high water levels in 1985-86. During this period, extensive damages to shore properties occurred from flooding and wave erosion during fall and spring storms along large sections of the Great Lakes shoreline. On Lake Erie, it is estimated that damages exceeded $20 million (Kreutzwiser 1987). In reaction to concern for public safety and associated costs, the Ontario Shoreline Management Review Committee (1986) recommended that shoreline management plans be prepared to address the issues of public safety, reducing property damages, and provisions for emergency assistance. In December 1987, the provincial government concurred with this recommendation, and conservation authorities were designated by the Ontario Ministry of Natural Resources as the implementing agency responsible for shoreline management on the Great Lakes in Ontario (McKeen 1990).

The purpose of this paper is to review and discuss initiatives in Great Lakes shoreline management and planning in Ontario within the context of international and provincial policies and programs and the growing interest in integrated resource management, ecosystem and watershed planning, and land use planning. An overview of the key issues and approaches in coastal management theory and practice provides a set of criteria which are used to assess the nature and content of three Great Lakes shoreline management plans. Improvements to the Ontario shoreline management program will be suggested based on experiences and concerns from different levels of government and international experience.

THE GREAT LAKES

The physiography of the 3000 kilometer shoreline of the Great Lakes in Ontario is varied, ranging from the forested rocky shore of Lake Superior, clay bluffs of Lake Huron, the sandy barrier spits on the north shore of Lake Erie, and the low bluff and rock platforms of eastern Lake Ontario (Figure 1). In Ontario, over 80 percent of the Great Lakes shoreline is privately owned, with urban development focused along the Toronto-Niagara Lake Ontario waterfront and major centres at the junction of lakes (Levels Reference Board 1993). The International Joint Commission (IJC) Levels Reference Board (1993) estimated that 40 percent of the Canadian Great Lakes shoreline is occupied by residential, commercial and industrial development, with forest (32 percent), and agriculture (17 percent) being the other main uses. Since the mid 19th century the Great Lakes shoreline has been utilized to its full capacity for resource extraction including timber, fish, minerals, oil and gas. Home to over 11 million people in Ontario, the basin has been under intensive pressure from competing uses including shipping, recreation and tourism, resource extraction, industrial development and conservation and protection initiatives (Dworsky 1986).

Along with being a resource base for the industrial heartland of Canada, the Great Lakes basin is a significant natural ecosystem supporting a wide range of species and habitats. The shoreline is often the focus of human activity and the home of wetlands, river mouths, bays, barriers and beaches all of which function as important biological systems. Over the last one hundred years rapid development with its mosaic of human uses has resulted in the fragmentation of natural habitats, alteration of physical systems such as stream flows, and degradation of the ecosystem health by pollutants, toxins, nutrients and waste (Weller 1990). When the many natural functions of the shoreline are combined with the exploitation of the landscape for resources and a disregard for the health of this environment, the result has

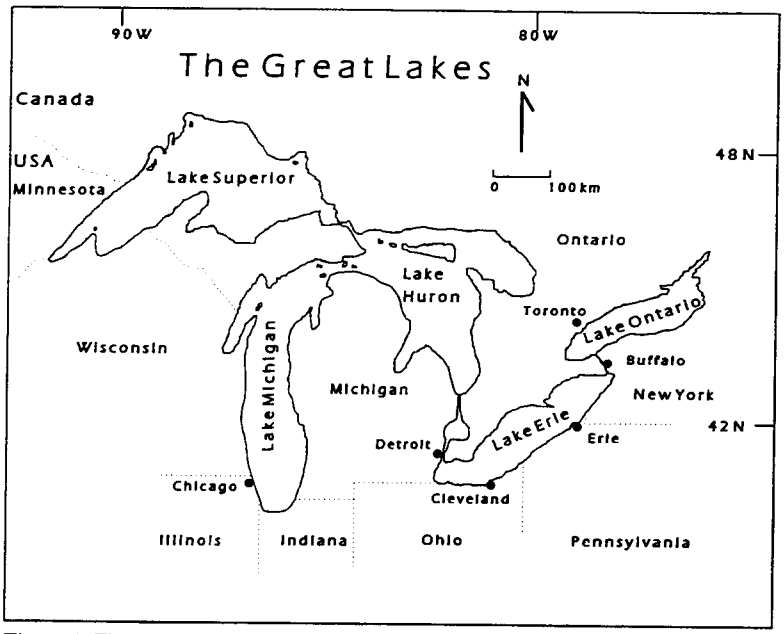

Figure 1: The Great Lakes

been a degraded, destroyed and declining ecosystem.

Basin Management

There have been a number of initiatives to consider integration of an ecosystem approach, sustainable development, and land use planning into a regional framework for management of the Great Lakes basin, including shorelines. Traditionally, management of the Great Lakes has been examined in terms of separate units or functions, for example: water quality, land use and development, industry, shore hazards, climatic conditions, fluctuating water levels, and wildlife habitat. Since the early 1970s there has been active discussion on the need to integrate the concept of ecosystem into management planning for the Great Lakes basin (IJC 1978, Lee et al. 1982, Vallentyne and Beeton 1988). The International Joint Commission was directed by the federal governments to provide further advice on the scope and implications of the ecosystem approach (IJC 1978). The ecosystem approach was seen as providing an integrative framework linking many resource issues, including water quality, fishery programs and human health, with those of other human activities. Although the IJC study recognized that an ecosystem approach is needed to manage the Great Lakes basin, little action or follow-up by federal governments and agencies occurred. The idea of a holistic approach based on the concept of a community and its environment functioning as an ecological unit has recently been revived within the context of sustainable development (Council of Great Lakes Research Managers 1993).

Vallentyne and Beeton (1988) suggest that the main obstacle to implementation of an ecosystem approach in the Great Lakes basin is the lack of comparable policies in the political jurisdictions surrounding the Great Lakes. Thomas et al. (1988) have also noted that until recently localized initiatives for the practical development of the concept have been lacking. The establishment of Remedial Action Plans (RAPs) by the Great Lakes Water Quality Board has begun to address this concern. However, to what extent do the RAPs fulfill the criteria for an ecosystem approach? The interpretation and application of integrity and the concepts of adaptability, sustainability and equity have all been used to characterize the types of cultural-nature interactions that are consistent with a goal of overall Great Lakes ecosystem management (Lee et al. 1982).

Shoreline Flooding and Erosion

The physical landscape, with intensive residential development that is located on extensive sections of severely eroding bluffs, beaches and low-lying sandy barrier spits, has produced a long history of human adaptation and adjustment to flooding and erosion hazards. The shoreline physiographic types prone to flooding and erosion range from sedimentary beaches (18 percent of shoreline length), bluffs/banks (10 percent) and wetlands (10 percent) (Geomatics 1992). These areas are also attractive for various types of land uses including seasonal residential cottages, industrial development, agriculture, and urban centres.

Fluctuating water levels on the lakes, a function of drainage, climate, and storm events, has lead to periods of rapid and extensive inland flooding and erosion of beach and bluff features (IJC 1993). The range of water levels on the Great Lakes exceeds two metres with short term, seasonal and long term variations (Figure 2). Changes in basin climate conditions, such as increased precipitation and cooler temperatures, can lead to gradual increases in water levels. High seasonal and annual water levels can combine with rapid localized changes from storm wave and wind activity to produce severe surge and seiche events. The impact of high water levels is to flood beach and dune areas and exacerbate nearshore, beach and bluff erosion due to increased wave action. In areas considered attractive to development, such as sand barrier complexes and beach areas, the result is increased damages to private property, infrastructure, and concerns for public safety.

GREAT LAKES SHORELINE MANAGEMENT IN ONTARIO

Management initiatives for the Great Lakes shoreline in Ontario can be linked to crisis responses during high water and related storm events (Table 1). Following high water levels in the early 1950s, a select committee of the Ontario legislature recommended municipal controls on hazard land development and provincial assistance for municipal acquisition of hazard shorelands (Ontario Select Committee on Lake Levels 1953), however only limited assistance for land acquisition was ever utilized (Kreutzwiser 1987). From 1973 to 1975, following record high water levels, the Canada-Ontario Great Lakes Shore Damage Group initiated a program of mapping 100 year flood and erosion limits for the shorelines of the Great Lakes in Ontario with monitoring of shore erosion conducted at 162 stations from 1973 to 1980 (Environment Canada/Ontario Ministry of Natural Resources 1975). The Ontario Ministry of Natural Resources assumed the task of defining and mapping shoreline hazard areas at a scale of 1:10,000, which was utilized by many municipalities to define hazard designations within official plans (Kreutzwiser 1987).

There was an attempt, under a joint federal-provincial task force, to develop a comprehensive approach to shore management by reducing flood and erosion hazards while encouraging economic and social utilization of the shore and minimizing adverse environmental effects (Environment Canada/Ontario Ministry of Natural Resources 1981). The Great Lakes Shoreline Management Guide adopted the principle of the shore zone as a system and provided goals and objectives for developing shoreline management plans, which would include land use planning, economic evaluation of management alternatives, understanding of natural processes, and assessment of environmental impacts. However, no follow-up or government action was ever undertaken on these recommendations.

In addition to provincial planning responses, a variety of federal government studies and programs have been undertaken in attempts to reduce Great Lakes shoreline flooding and erosion. Since 1921, water regulation and diversion schemes have been used in attempts

Key programs and initiatives undertaken by the federal and provincial governments in reference to land uses, water level regulation, scientific studies, and related policies.

1927	Lake and Rivers Improvement Act - Provincial legislation to regulate alteration of natural waterways.
1946	Conservation Authorities Act - Provincial legislation to establish conservation authorities on watersheds.
1948	Planning Act - Provincial legislation to establish standards for land use planning and official plans.
1952-53	Great Lakes High Water Levels - Period of major flooding related to storms and record high lake levels.
1953	Selective Legislative Committee on Water Levels - Provincial study of causes and impacts of lake levels.
1972	Ministry of Natural Resources Act - Establishes provincial ministry to oversee natural resource policy.
1972-73	High Water Levels on Great Lakes - Period of severe damages from flooding and erosion on the Great Lakes.
1972	Shoreline Property Assistance Act - Provision for loans to property owners for shore protection projects.
1972	Canada/Ontario Great Lakes Shore Damage Survey - Government study into causes of shore hazards.
1972	Great Lakes Shoreline Hazard Mapping- Ontario Ministry of Natural Resources assumes responsibility for hazard mapping to be provided to local municipalities.
1973-81	Great Lakes Shore Erosion Monitoring Program - Annual monitoring of 162 sites prone to shore erosion by use of aerial photography and field studies.
1976	Great Lakes Coastal Zone Atlas - Complying of data concerning shoreline conditions and mapping.
1976	IJC Report on Further Regulation of Water Levels - Examination of additional regulation schemes.
1981	Great Lakes Shore Management Guide - Canada/Ontario study proposing shoreline management practices.
1981	IJC Lake Erie Water Level Study - Proposal for further water level regulation by constructing structures on the Niagara River.
1983	Planning Act revised - Provisions for stronger land use planning, official plan development, and provincial policy statements.
1985-86	High Water Levels on Great Lakes - Record high monthly water levels on Lake Erie accompanied by severe storm events.
1986	IJC Water Levels Reference Study - Review of the factors contributing to Great Lakes shoreline flooding and erosion from recent high water levels.

Table 1: Historical Development of Shoreline Management in Ontario

1986	Ontario Shoreline Management Review Committee - Established by the provincial government to examine the issue of a long-term approach to Great Lakes shoreline management.
1986	Ontario Shoreline Management Program-Ontario Ministry of Natural Resources designated as the lead agency for the development of Great Lakes Shoreline Management Plans.
1987-89	Ontario Shoreline Advisory Council - Established to solicit public opinion on shoreline management and assist in education.
1987	Guidelines for Ontario Shoreline Management Plans - Outline the components to be included in plans prepared by conservation authorities or OMNR districts.
1987	Canada/Ontario Flood Damage Reduction Program - Joint government program to provide funding for mapping of flood prone areas.
1988	Extension of CA responsibility into Great Lakes - Provision for conservation authorities to consider nearshore components into plan and program development.
1988	Great Lakes Wave Climate/Littoral Cell studies - Completion of scientific studies examining geomorphic processes including wave energy and sediment transport.
1988-92	Royal Commission on the Future of the Toronto Waterfront - Joint federal/provincial study of the waterfront lands, public access, and ecosystem health generally.
1989	IJC Water Levels Reference Study Progress Report - First stage completed of study outlining research results and future studies.
1990-94	Draft Great Lakes Shoreline Flood and Erosion Hazard Policy Statement - Definition of regulatory land use setbacks for 1:100 year flood, 100 year erosion line and dynamic beach.
1992	Provincial Wetlands Policy Statement - Definition of class wetlands and provisions for no net loss policy and implementation guidelines.
1992	Toronto Waterfront Regeneration Trust - Established to follow-up on the final recommendations of the commission with special interest in greenways, public access and shore management.
1992-95	Re-organization of Ontario Ministry of Natural Resources - Review of internal land use policy and program development, role of public participation, and future ministry directions.
1992-93	Commission on Planning and Development Reform - Examination of land use planning in Ontario including role of municipalities, application process, and public involvement.
1993	IJC Levels Reference Study final report - Recommendations to federal government regarding water level regulation schemes and shoreline management.
1994-95	Provincial Planning Reform in Ontario - Revisions to the Planning Act including policy statements, ecosystem planning and municipal official plan preparation.

Table 1: (continued)

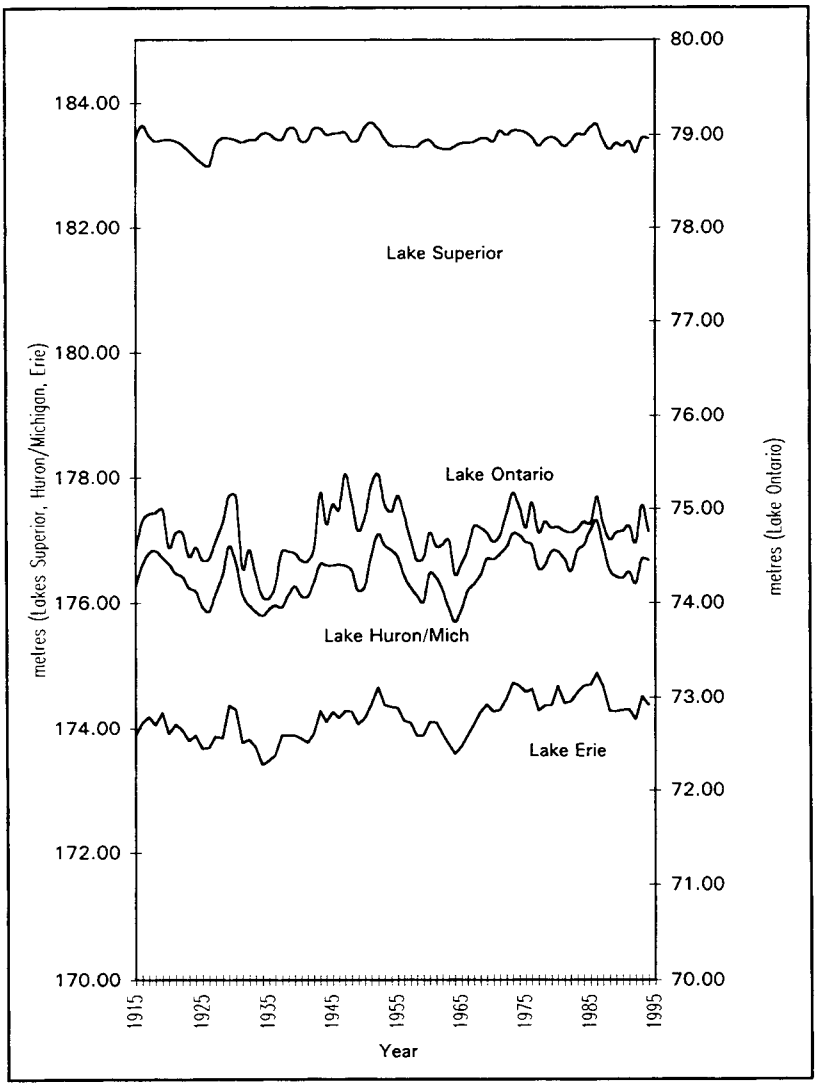

Figure 2: Mean annual water levels of the Great Lakes from 1915 to 1994. Indicates fluctuations in the levels with extreme events in 1951/52, 1972/73 and most recently in 1985/86. Data from Environment Canada. Note different scale for Lake Ontario levels.

to control water level fluctuations. Structures currently exist on the St. Marys River outlet of Lake Superior and on the St. Lawrence River system. Five major water diversion projects are located at sites on Lake Superior, Lake Michigan and the Niagara River. In addition hydroelectric power generation operations affect discharge through several of the outlets. The combination of these engineered projects has the potential to partially control water levels on Lake Superior and Lake Ontario. The operation and compliance is ensured by a series of regulation schemes directed by the water control boards of the International Joint Commission. Due to the range of extreme natural variations in basin precipitation, drainage and evaporation, the current ability of these controls to reduce annual water levels on the order of 0.09 to 0.33m is much lower than the natural fluctuations ranging from 1.2 to 2.0m (IJC 1989). In spite of this fact, a continued public and political preoccupation with water level regulation as a means of reducing damages from shoreline flooding and erosion has caused limited government interest in a broader and long term management approach.

Great Lakes shoreline management has also been hampered by the absence of a federal coastal management program. Although a number of attempts have been made over the last twenty years to develop a Canadian coastal management program or policy, various initiatives have failed (Canadian Council of Resource and

Environmental Ministers 1978). Hildebrand (1989) has suggested that several barriers remain to the implementation of a federal coastal zone policy including: a lack of political and public awareness, administrative fragmentation, inadequate information, no clear motivation, and the dominance of short term versus long term management. As a result, even with numerous federal programs and initatives in many coastal regions, including the Great Lakes, the development of a comprehensive national policy appears to be as distant as it was twenty years ago as none of the issues have been resolved.

Provincial Shoreline Management Program

Following high water levels in 1985 and 1986, a provincial committee recommended stronger provincial action related to shore hazard planning and land uses affected by water level fluctuations and subsequent flooding and erosion damages (Ontario Shoreline Management Review Committee 1986). A proposal was made for the establishment of a provincial shoreline management program administered by the Ontario Ministry of Natural Resources (OMNR). Conservation Authorities or OMNR districts were designated as the implementing agencies to develop Great Lakes shoreline management plans (Figure 3). Through the direction and programs of the OMNR, local municipalities, branch OMNR offices and conservation authorities can receive information and services related to erosion and flood risk mapping, funding for shoreline projects, access to a geographical information system (GIS) information base, and technical assistance (McKeen 1990). In conjunction with researchers at Environment Canada, OMNR staff provide the implementing agencies with expertise related to shoreline process and management approaches. Studies of wave climate, littoral cells, and sediment transport have been completed in addition to staff training.

In Ontario, land use planning along the Great Lakes shoreline is implemented by individual municipalities and townships through the use of official plan designations and local zoning bylaw regulations under the provincial Planning Act. The Ontario Ministry of Natural Resources (OMNR) prepared a hazard lands program based upon engineering studies to delineate areas prone to flooding and erosion. In terms of eroding shoreline that line was defined as:

> 'erosion susceptibility delineations determined in a manner acceptable to OMNR and/or the local conservation authority and based on estimated rates of erosion over a one hundred year period, as determined by studies considering the degree of slope, the eroding agents, the type of material, historical records and any other information available regarding slope stability' (Environment Canada/Ontario Ministry of Natural Resources 1981, p. 10)

As a result of this broad definition, a number of different methods were employed by local townships, municipalities and conservation authorities. A combination of minimum elevation, various setback calculations and allowance for shore protection are employed (Kreutzwiser 1987). For example, the Township of Malahide on Lake Erie does not allow development closer than a setback calculated from the bluff height and rate of erosion per year at the point under consideration (Davidson-Arnott et al. 1991). In contrast within the Regional Municipality of Haldimand-Norfolk, Lake Erie, building setbacks are imposed from the margins of defined hazard areas, including the shoreline, on a site specific basis in relation to the kind, extent and severity of existing and potential hazards and a recession zone is applied for areas mapped under the Canada/Ontario Great Lakes Flood Damage Reduction Program (FDRP) (Lawrence and Nelson 1994).

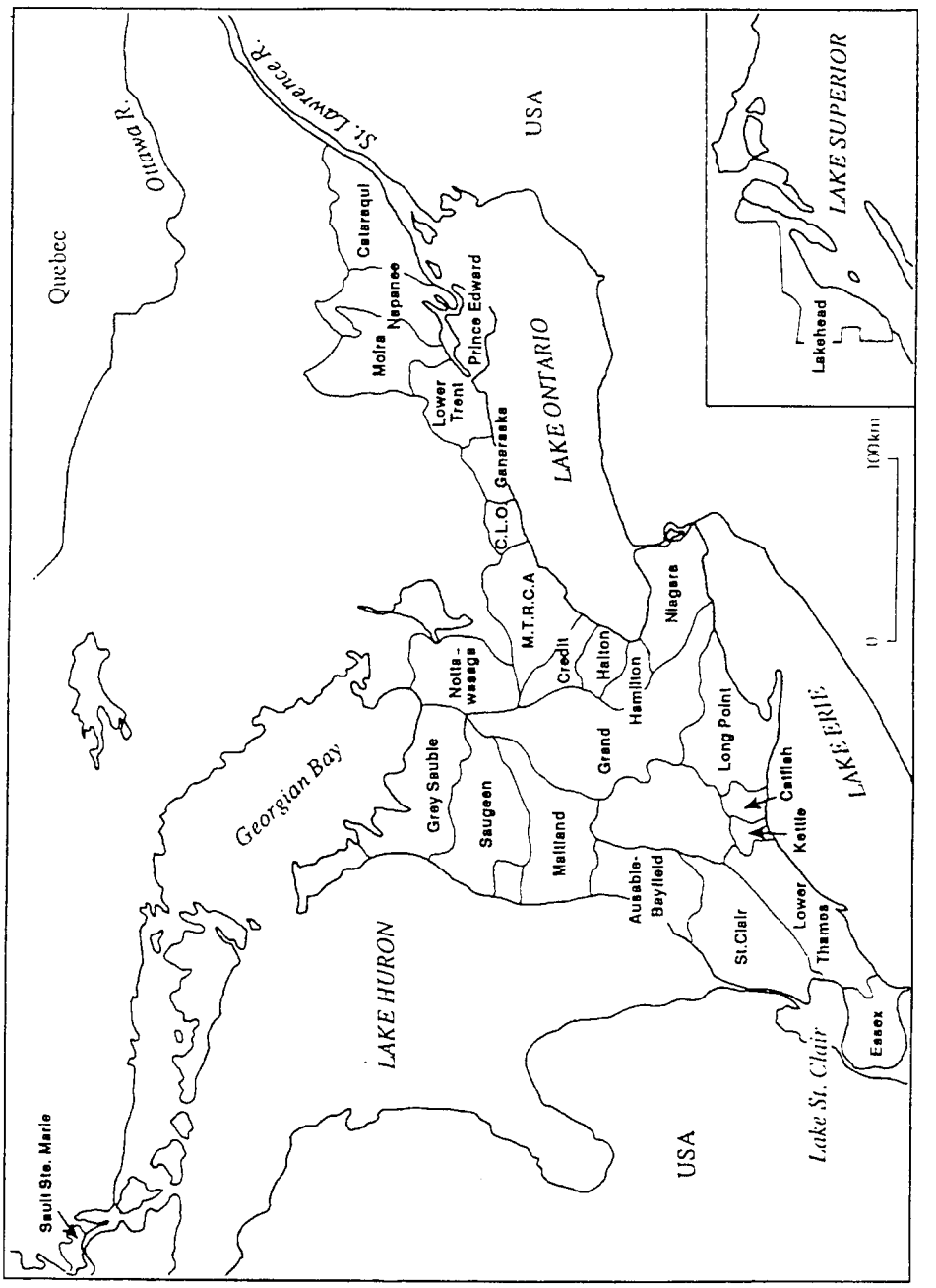

Figure 3: Ontario Conservation Authorities on the Great Lakes shoreline. From Kreutzwiser and Slatts (1994), used with permission.

Along with problems with definitions, setbacks from top of bluff suffer from several other operational and philosophical problems in regard to long term land use planning. Exactly how does one determine an acceptable planning setback? Is one hundred years of erosion an appropriate length of time between establishment of current development and its imminent destruction? Currently, recession rate data are only available from Great Lakes Erosion Monitoring Program stations, many of which have not been updated since 1986 and were measured from aerial photography and present potential interpretation error. In addition, historic survey records and aerial photography coverage are incomplete for large sections of the shoreline, therefore the information base on which to determine long term recession rates is deficient.

In cooperation with local governments, conservation authorities are taking a lead role in the establishment of consistent shoreline flooding and erosion hazard policies (McKeen 1990). Fill and construction regulations, under section 28 of the Conservation Authorities Act, have been extended from floodplains to include shorelines by 5 of 27 authorities along the Great Lakes (Slaats and Kreutzwiser 1993). These regulations permit the conservation authorities to control the construction of dwellings, protection works and other structures along the shoreline (Kreutzwiser 1987). It is anticipated that more conservation authorities will apply for fill regulations and become more directly involved in the definition and enforcement of land use restrictions for high risk shoreline hazard areas.

Great Lakes Shoreline Flooding and Erosion Policy Statement

In 1990 work began on a new provincial policy statement on Great Lakes shoreline flooding and erosion hazards that was to provide a standard for land use setbacks in Ontario (McKeen 1990). The policy would clarify the shoreline hazards definition and establish provincial guidelines for determining and applying regulatory flood and erosion standards along the Great Lakes shoreline (Ontario Ministry of Natural Resources 1990). A draft policy was prepared based on the objectives of reducing risks to life and property and encourage a coordinated approach in the wise use and management of lands susceptible to Great Lakes flooding and/or erosion (Ontario Ministry of Natural Resources 1990). The principles of the policy were proposed as:

1) to manage on a littoral cell unit;

2) to understand local conditions;

3) to acknowledge that the degree of risk varies between shore areas;

4) to not permit new development that is susceptible to, or will cause/-aggravate, the hazards, unless the hazards have been overcome;

5) to undertake development in an environmentally sound manner; and

6) to improve coordination with other agencies involved in aspects of shoreline management and planning.

It was anticipated that a greater appreciation for the diversity of shoreline processes would be reflected in the policy and allowances were made for more detailed management strategies in areas where development was at greatest risk.

The draft policy as stated had a bias towards the use of engineered shore protection structures to reduce the hazard losses, although this principle is flawed and often ignores environmental impacts to the system. By utilizing setbacks and the one hundred year erosion line, the policy is missing many important site specific variations which occur

along the Great Lakes shorelines. The shoreline hazards which result from the diversity in alongshore characteristics are often greater then the hazards represented by recession rates even if we accept those values as accurate and representative. Comprehensive long term management must incorporate detailed site specific planning in order to be effective. The limitations placed on setbacks by their operational difficulties result in an ineffective and short term solution.

McKenzie (1991) argued that principles of ecosystem planning must be integrated into the Ontario Great Lakes shoreline flooding and erosion policy. McKenzie contends that shoreline management and planning should place more emphasis on maintaining the ecological integrity of the shoreline rather than focusing solely on public safety and property damage issues. The policy needs to provide a commitment to promote the sustainable development of shorelines. The key components of such a policy should be:

1. to maintain ecological integrity of essential coastal systems;

2. to reduce the potential for loss of property and loss of life; and

3. to promote development that is sustainable (McKenzie 1991).

Alongshore sediment transport, or littoral drift, is the primary natural process to be managed and development standards for deposition and erosion zones are required, in addition to identifying the degree of potential hazard associated within development at those sites.

Internal review of the policy continued from 1990 to 1993 with the preparation of implementation guidelines and the intention to introduce the policy to the provincial cabinet for approval for release and public review. Progress was delayed, however, with the introduction of the Commission on Planning and Development Reform in Ontario (Sewell Commission) in 1991. It was anticipated that the policy statement would be developed and included in the final recommendations and planning documents of the commission. With the release of the provincial government's response to the Sewell Commission in 1993, and subsequent revisions to the Planning Act with Bill 163 in 1994-1995, the Great Lakes shoreline flooding and erosion hazard policy statement has been incorporated into a comprehensive policy statement on natural heritage, environmental protection and hazards.

Ontario Conservation Authority Shoreline Management Plans

A main component of the provincial program is the preparation of shoreline management plans by Ontario conservation authorities and OMNR districts (OMNR 1987). Currently these agencies are in various stages of plan development, including the acquisition of shoreline aerial photography, completion of flooding and erosion hazard mapping, and background and base resource inventory studies (Lawrence and Nelson 1993). Three completed shoreline management plans were selected for review: Sault Ste. Marie OMNR District, Catfish Creek CA, and Long Point CA. These cases were selected to represent a range of management approaches and adaptation of the provincial guidelines (OMNR 1987). Since no financial data is available to determine priorities in the programs, and no published evaluation of the Ontario provincial program or individual plans has to date been completed, information was taken directly from the individual plans.

To assess the shoreline management plans, a content matrix was developed to identify key components as suggested in previous evaluation studies (Noble et al. 1978, Feldmann and McCrea 1978). The components are categorized into three types: issues, processes, and mechanisms. Does the plan define each of the components and

assess the current status within the planning jurisdiction? A set of issues have been identified from previous studies and discussions regarding the components of a integrated coastal zone management approach (Sorenson et al. 1984, OECD 1993). Processes involved in plan implementation are also determined. The review identifies the use of mechanisms within each plan including the various regulations and permits.

As seen in Table 2, collectively the plans reflect the nature and content of the provincial guidelines (OMNR 1987). The focus in the planning process is on the assessment and

	Sault Ste. Marie OMNR[1]	Catfish Creek CA[2]	Long Point CA[3]
Issues			
Ecosystem Boundaries	NA	NA	NA
Natural Resources	x	NA	NA
Water Use	NA	NA	NA
Pollution	NA	NA	NA
Flood and Erosion Hazards	x	x	x
Cultural Resources	NA	NA	NA
Historical Land Uses	NA	NA	NA
Economic Activity	NA	NA	NA
Public Access	NA	NA	NA
Ports/Marinas	NA	NA	NA
Process			
Local Planning Scale	x	x	x
Identification of Priority of Uses	?	?	?
Development Promotion	NA	NA	NA
Public Participation	x	?	x
Education	NA	NA	NA
Mechanism			
Environmental Protection	x	NA	NA
Regulations	x	x	x
Land Use Permits	x	x	x
Use of Setbacks	x	x	x
Critical Areas	NA	NA	x

x - major component within plan NA - not applicable ? - uncertain

1 Ontario Ministry of Natural Resources (1991). *The Sault Ste. Marie District Shoreline Management Plan 1991 - 2011.* Sault Ste. Marie District, Sault Ste. Marie, Ontario.

2 Philpott Associates (1989) *Shoreline Management Plan* Catfish Creek Conservation Authority, Alymer, Ontario.

3 Philpott Associates (1989b) *Shoreline Management Plan.* Long Point Region Conservation Authority, Simcoe,Ontario.

Table 2: Ontario Great Lakes Shoreline Management Plans Content Evaluation Matrix

mitigation of flood and erosion hazards. Shoreline development is to be controlled by land use regulations which limit development in areas prone to reoccurring flooding and erosion. Setbacks which are based on the 100 year erosion line and include a stable slope, a 1:100 flood level with a wave uprush calculation, and a dynamic beach zone for beach and dune environments are the common plan mechanisms. The plans also include the premise that if an engineered structure, such as a groyne, wall, breakwater, or revetment, can reduce the threat from the hazards then development can locate within the hazard area.

Very little attention, often only a few pages within the plans, is given to environmental concerns such as protection of significant natural features including wetlands, natural processes, fauna or flora. The Sault Ste. Marie OMNR plan has identified shoreline environmental protection areas in an attempt to recognize important natural features that occur along the Lake Superior shoreline. The majority of these protected areas are wetlands, many of which have already been identified in other planning documents. Their designation within the shoreline management plan provides for recognition of their importance to the shoreline ecosystem and supports the need for integrated management of Great Lakes shorelines.

It is apparent that the shoreline management plans completed to date reflect the concern for flooding and erosion hazards highlighted in the provincial guidelines and lack sufficient information, policy and program implementation of key land use and environmental issues fundamental to an integrated approach to coastal management. Human and cultural components deemed important to integrated management are largely ignored by the existing plans. Provisions for public consultation are limited, as are communication and education initiatives. Other principles of integrated coastal zone management not contained within the plans are preserving and protecting productivity and biodiversity, provisions for conflict resolution and management coordination, and the concept of sustainable development. With international support and interest in a broader ecosystem based management of coastal and marine environments, Ontario will need to develop a program and planning approaches to Great Lakes shoreline management which will reflect these concerns.

1.	Political and public commitment
2.	Visionary or strategic long term perceptive
3.	Planning for uncertainty with flexible and proactive approaches
4	Ecosystem units as a basis for planning (watersheds)
5.	Recognition of significance Great Lakes ecosystems
6.	Consider erosion and flooding hazards in a land use and environmental context
7.	Mechanisms for cooperation and coordination
8.	Adequate information and scientific basis
9.	Develop systems of evaluation, assessment, and monitoring
10.	Provisions for education, public awareness and communication

Table 3: Concepts for a Great Lakes Integrated Coastal Ecosystem Management Program

Related Land Use Management Programs and Policies

In the last few years several initiatives within the province have developed that may indirectly influence the evolution of the provincial Great Lakes shoreline management program and plan preparation. In central Ontario, the main management issue of shore development on interior lakes is concern for the carrying capacity of land uses as related to potential nutrient loading (Ontario Ministry of Municipal Affairs 1986). The official plan of the Municipal District of Muskoka recognizes the importance of maintaining water quality and ecosystem health of the lakes. Planning controls are in place to review development on the lakeshore as a function of the ability of the aquatic ecosystem to handle increased phosphorus, nitrates, pH, and sediments. The planning process could be modified to include the range of factors of contributing to the sensitivity to nutrient input including the type of lake, lake bottom and terrain characteristics. Structured types of development such as ribbon, single lot, clustered, waterfront, back-lot, dense, or scattered land uses can then be proposed to limit environmental impacts based on site conditions (Drouin 1993).

For over twenty years a wealth of information related to the concept of Great Lakes ecosystem management has existed (Lee et al. 1982, Vallentyne and Beeton 1988), but the emphasis has been on land use issues related to water quality (IJC 1994). Land use based management programs on the Great Lakes include the 1978 Great Lakes Water Quality Agreement, development of Remedial Action Plans in forty three Areas of Concern, preparation of Lakewide Management Plans by Environment Canada and the United States Environmental Protection Agency, and the Canadian Great Lakes Action Plan (GLAP). The principal goals of these programs are to accelerate the clean-up of contaminated areas and prevent future pollution through remediation, conservation, environmental technology, and preservation (IJC 1994).

A number of agencies have promoted an ecosystem charter for the Great Lakes-St. Lawrence (Rawson Academy of Aquatic Science 1990, Council of Great Lakes Research Managers 1993). The idea is to consider an extension of the ecosystem approach as part of the challenge of sustainable development. The new focus of Great Lakes management is to create a sustainable future by managing human use and reducing abuse of an ecosystem in which people are but one part. It is essential to link land uses to the range of environmental impacts which include changes in water quality, habitat loss, and the disruption of natural processes such as sedimentation and drainage.

The recent Lake Levels Reference Study examined methods of alleviating adverse consequences of fluctuating water levels in the Great Lakes basin by recognizing implications of the nature-human interaction on water levels (IJC 1993). The final report to the federal governments acknowledged that the systemic essence of the nature-human complex means that specific measures aimed at affecting system-wide water level are probably futile. The final recommendations, based upon almost eight years of scientific and policy research and public consultation, reflect a movement away from increased water level regulation schemes towards more emphasis on land use planning and human adaptation to the Great Lakes ecosystem.

Toronto Waterfront Regeneration

The Royal Commission on the Furture of the Toronto Waterfront (Crombie Commission), established in 1988, discussed the development of a management policy and future planning directions for the Toronto waterfront on Lake Ontario. The Commission acknowledged the need for a broad ecosystem approach to deal with the complexity of issues characteristic of shoreline ecosystems. In their

final report the Commission promoted waterfront regeneration as an opportunity that brings with it the long-term promise of a healthy environment, economic recovery and sustainability, and the maintenance of a livable community (Royal Commission on the Future of the Toronto Waterfront 1992). With respect to shoreline management, the important conclusions from the Crombie Commission are recognition of the need for regional planning and cooperation, a shift from traditional to ecosystem based decision making, promoting a quality of life for a healthy community, understanding the sustainability of the ecosystem, and the need to regenerate the Lake Ontario shoreline.

The major shoreline concerns facing the Toronto waterfront and many other urban Great Lakes shoreline regions are infilling and shore protection, pollution and water quality, waste, and public access. The Commission suggested that principles for regenerating the waterfront include: clean, green, connected, open, accessible, useable, diverse, affordable, and attractive (Royal Commission on The Toronto Waterfront 1992). The Crombie Commission proposed a framework for ecosystem based planning that would define scope, purpose, and the roles of stakeholders, establish management goals, gather information, assess ecosystem health, designate alternative planning scenarios, build consensus, develop mechanisms for review and approvals, and make commitments for implementation, monitoring, compliance, and evaluation. The newly established Toronto Waterfront Regeneration Agency Trust is developing a shoreline regeneration plan for the Lake Ontario shoreline from Burlington to east of Toronto. This plan would focus on the protection of the remaining natural areas, rehabilitation of degraded sites, evaluation of cumulative environmental effects, improvement of public access, and establishment of a greenway trail.

Land Use Planning Reform in Ontario

The current political environment for land use planning in Ontario is focused on the Commission on Planning and Development Reform in Ontario (Sewell Commission). It is worth a few comments on how recommendations from the Commission may effect shoreline development along the Great Lakes. In addition to changes to the structure and methods of planning in Ontario, the Commission has discussed several issues of relevance to shoreline management including strategic and integrated planning, the detailed pattern of land use and density, managing rapid rural and urban changes, the role of upper-tier (county or region) planning, maintaining and enhancing environmental quality, municipal planning on an ecosystem (watershed) basis, the role of conservation authorities in planning, and the use of septic systems for rural residential waste (Commission on Planning and Development Reform in Ontario 1993).

In December 1993 the Minister of Municipal Affairs announced that the provincial government had accepted several recommendations from the Sewell Commission and released a discussion paper for public comment (Ontario Ministry of Municipal Affairs 1994). In November 1994 the provincial legislature passed Bill 163 which evoked revisions to the provincial Planning Act and related planning and municipal affairs (Legislative Assembly of Ontario 1994). Included within these revisions is the development of a provincial policy statement on natural heritage, environmental protection and hazards. One goal of this comprehensive policy statement is to regulate development adjacent to the Great Lakes. The draft Great Lakes shoreline flooding and erosion hazard policy statement developed by the Ontario Ministry of Natural Resources has been incorporated into this new broader provincial policy. New development will not be permitted within defined portions of the 100 year flood

level, a dynamic beach standard which protects significant beach and dune sites, and an erosion regulatory standard. The regulatory erosion standard is to be based upon consideration of the influence of a stable slope, historical recession rates, and/or erosion allowance (Ontario Ministry of Municipal Affairs 1994).

The impacts of the new Planning Act remain uncertain because formation of policy and technical guidelines are ongoing. Local municipalities, whose role it will be to apply the policies, will need to revise existing planning and land use zoning documents to reflect the provincial guidelines. The ability and incentive of the various municipalities to undertake such revisions is uncertain. Interpretation of the implementing guidelines for the policies is also an issue in regards to the application of the provisions of the act. In addition, recent provincial funding reductions, particularly to the Ontario Ministry of Natural Resources, cause concern about the ability to properly establish, monitor and enforce the new regulations. These cutbacks have effectively eliminated technical and staff support for the provincial shoreline management program and limited the development of plans by the conservation authorities.

It is certain, however, that significant changes to the land use planning mechanisms in Ontario will result from the revised Planning Act. The potential impact of these changes on shoreline development is not clear as no recognition of the significance and uniqueness of shoreline planning is given. Certainly revisions to the role of municipalities in land use planning will have a fundamental impact on the formation of shoreline management plans, regulation of shoreline development and uses, and attempts at ecosystem planning along the Great Lakes shorelines.

DISCUSSION

The term management implies a system that sets goals and priorities and then chooses the most effective and efficient means to those ends. Components from resource management, such as natural hazards, risk assessment, crisis theory, sustainable development and ecology have become part of coastal management practice. Ditton et al. (1977) suggest that one goal of coastal resource management should be to define and preserve coastal carrying capacity, with appreciation of the relative strengths and weaknesses of the public and private sectors and assess the variability of the critical threshold for coastal ecosystems.

With the establishment of the United States Coastal Zone Management program in 1972, the development of state management plans was based on understanding the range of issues and concerns facing the coast. Hite and Stepp (1971) have stated that coastal zone management must incorporate the concept of multiple use either by accommodation or by balancing uses in conflict. The problems arise in quantifying amenity or environmental values, the lack of sufficient information to which to base management decisions, and the notion that some activities are irreversible and have a drastic effect on the natural environment. Brahtz (1972) proposed a systems approach to coastal management, focusing on objectives planning, strategic planning, evaluative planning, and selection of strategy or problem solution for implementation.

The measures best suited to conserving ecological resources are often the same measures needed to preserve natural landforms that serve as barriers to storms and flooding. Coastal environmental management can be seen as a combined approach to hazards and resource management that simplifies the process of zoning and permit reviews and leads to more predictable decisions on what constitutes acceptable development (Conservation Foundation 1980). This approach emerged from the concern for environmental health and integrity that developed in the late 1960s. The approach is based on the assumptions that well planned

development will add to the overall prosperity of a coastal community, that management should aim to enhance the coastal ecosystem's natural carrying capacity, and that hazard protection begins with the preservation of coastal landforms which provide natural resistance to flooding and erosion. Clark (1983) proposed that a program for conservation of coastal ecosystems should consist of four major elements: protection of all ecologically vital areas, elimination of all damaging discharges of pollution, control of the alteration of shorelands, and control of excavation and alteration of coastal water basins. The land use planning would require a system of identification and classification of general areas of critical environmental concern.

To improve planning along the Great Lakes shoreline, a provincial program must include management principles (Table 3) based on an ecosystems approach and draw from existing coastal management theory and international experience and practice as highlighted. Such a program could be developed under the existing management arrangements by which individual conservation authorities prepare shoreline management plans. What is needed, however, is stronger provincial support for the program and provisions for coordination and cooperation between the variety of agencies currently responsible for components of the proposed integrated coastal ecosystem management program (Table 3). This would include the various provincial ministry watershed and ecosystem planning and management programs currently in development (OMNR 1992, Ontario Ministry of Environment and Energy 1993).

Within the Great Lakes ecosystem an understanding of human interaction with the environment is critical. Land use activities are a key component of understanding and managing coastal ecosystem. Development and resource use in the coastal zone has been and will continue to be a major activity. Management programs must recognize this fact and attempt to build planning strategies that reflect basic principles of ecosystem management and an understanding of human impacts in the evolution of coastal environments. Management and planning systems need to be flexible, comprehensive, adaptive, pluralist, proactive and equitable.

Development of such an integrated coastal ecosystem management approach relies on creating a knowledge base, promoting understanding and public awareness, and moving towards integration of environmental concerns with the need for sustainable development. This perspective is wide-ranging, broad in its geographical or spatial scope and is based on a value assessment of what the coast is and means to society. The current management system, with its focus on resources and hazards needs to be shifted towards an emphasis on understanding the coast, not a single linear shoreline, but part of a complex land and water based ecosystem.

CONCLUSIONS

We can learn from the range of coastal management approaches outlined in theory and practice. In Ontario, shoreline management as a planning tool did not really exist prior to 1987. The approaches to addressing flood and erosion hazards have been dealt with on an individual, site specific, crisis-response, short term, reactive basis. The issues usually associated with an ecosystem management model, such as water quality, identification of significant resources or features, ecological protection or enhancement, and securing public access, have not been built into a unified management framework. Historically, political and management responsibilities for these components of coastal ecosystem management have been divided between various government agencies at all levels and various scales.

There is a need to develop a strategic approach to Great Lakes shoreline

management in Ontario to deal with the range of issues fundamental to the coastal ecosystem and to provide a long term management perspective and strategic vision. In the past, policy and program development have been directly tied to the crisis of high water levels and the immediate public concern and government responses. Recently, funding for the development of shoreline management plans has been diverted into support for the preparation of the provincial Great Lakes flood and erosion policy statement. There currently is also concern over the future development of the plans given the financial restraint in provincial funding to the government ministries and the conservation authorities.

A Great Lakes coastal management program should reflect the fundamental principles guiding an ecosystem approach and an ability to operationalize these ideals and concepts. Management can be considered to be a multidimensional method of allocating resources and uses of the coastal zone to society. As such, it is based upon an understanding of the complex natural and human components of the landscape and an appreciation for the structure and processes related to the coastal ecosystem. To plan resource use in the coastal zone requires knowledge of the interactions between species, habitats, natural features, nutrients, water flow, and sediments as well as the human components including resource use, development, land use, economic values, perceptions, understanding, social values and significance, and amenities.

In the province of Ontario, the work of the Toronto Waterfront Regeneration Trust Agency provides an excellent opportunity to consider an ecosystem perspective on planning the Great Lakes coast. The development of shoreline management plans by Conservation Authorities and separate planning initiatives such as land use planning reform, Great Lakes ecosystem health programs, lake level management, lake basin planning, ecosystem rehabilitation programs, remedial action plans, and pollution clean-up projects need to be built into, not separate from, the development of land use based planning of shorelines. Here is an opportunity to use the principles of coastal zone management and existing Great Lakes management practices to create a framework for Great Lakes integrated coastal ecosystem management in Ontario.

POSTSCRIPT

On March 28, 1995 the Comprehensive Set of Policy Statements adopted under Section 3 of the provincial Planning Act came into affect. Review of the Implementation Guidelines for the policy statements reveals several important issues relevant to Great Lakes shoreline management. Under the Natural Heritage Features and Environmental Protection Policy (A1.2, A1.4), shorelines of inland lakes including the Great Lakes, are to be classified into areas where either no development is permitted or where development may be permitted if it does not negatively impact the features or the ecological functions of the shoreline. This provision will require detailed mapping of significant Great Lakes shoreline features and functions, a task which has never been attempted. Such inventory and assessment will provide for the first time full consideration of ecological processes or benefits in Great Lakes shoreline management in Ontario.

Under the policy for natural hazards (A3.1, A3.2, and A3.3), the province is requiring comprehensive ecosystem based planning to integrate environmental concerns, such as natural hazards, into the land use planning process. Policy A3.1.1 defines the Great Lakes regulatory shorelines and provides for land use setbacks in those areas prone to reoccurring flooding and erosion. It appears that the Great Lakes shoreline management program has been superseded by the establishment of a new provincial natural hazards program which incorporates the goals and objectives as originally defined in the 1987 Great Lakes

shoreline management guidelines. A set of eight principles reflecting comprehensive and ecosystem management of hazards and land use planning have been adopted for the program.

The immediate and long term impacts of land use planning reform in the province remain uncertain. The effects of combining the Great Lakes shoreline hazards into a broader natural hazards program may have led to the demise of the provincial shoreline management program. In addition the documentation for the planning reform makes reference to the preparation of integrated shoreline management plans (ISMPs), however discussion with individual conservation authorities indicate that no new provincial guidelines for the plans have been released. In light of such changes the very future of Great Lakes shoreline management in Ontario is in doubt.

ACKNOWLEDGMENTS

This paper was edited from a comprehensive examination paper submitted by the author in partial fulfillment of a Ph.D. degree in Geography at the University of Waterloo. The author wishes to thank the two anonymous referees and Deanna Van Dijk, University of Waterloo, for their comments and suggestions on an earlier draft. Funding was provided in part by graduate student support from the Department of Geography at the University of Waterloo and a Social Sciences and Humanities Research Council of Canada research grant to Dr. J. Gordon Nelson, who acted as graduate advisor.

REFERENCES

Brahtz, J.F.P. 1972. *Coastal Zone Management: Multiple Use with Conservation.* New York: John Wiley and Sons.

Canadian Council of Resource and Environmental Ministers. 1978. *Proceedings of Shore Management Symposium - 1978.* Vancouver: British Columbia Ministry of Environment.

Clark, J.E. 1983. *Coastal Ecosystem Management.* New York: John Wiley & Sons Ltd.

Commission on Planning and Development Reform in Ontario. 1993. *New Planning in Ontario: Final Report Summary and Recommendations.* Toronto, Ontario: Publications Ontario.

Conservation Foundation. 1980. *Coastal Environment Management: Guidelines for Conservation of Resources and Protection against Storm Hazards.* Washington, D.C: U.S. Government Printing Office.

Council of Great Lakes Research Managers. 1993. *Development of a Great Lakes-St. Lawrence Ecosystem Model Framework.* Ottawa, Ontario: International Joint Commission.

Davidson-Arnott, R.G.D., Ollerhead, J. and Lawrence, P.L. 1991. *Assessment of the Policy Setback Requirements on Municipal Official Plans and Zoning Bylaws for Great Lakes- St. Lawrence Shoreline.* Toronto, Ontario: Ontario Ministry of Natural Resources, Lands and Water Policy Branch.

Ditton, R.B, Seymour, J.L. and Swanson, G.C. 1977. *Coastal Resources Management: Beyond Bureaucracy and the Market.* Lexington: D.C. Heath and Company.

Drouin, C. 1991. *Lakeshore Development in the Muskoka District: An ecological approach to assist the development approval process.* unpublished M.A. thesis, Department of Environmental Resource Studies, University of Waterloo, Waterloo, Ontario.

Dworsky, L.B. 1986. 'The Great Lakes: 1955-1985'. *Natural Resources Journal* 26: 291-336.

Environment Canada/Ontario Ministry of Natural Resources. 1975. *Canada-Ontario Great Lakes Shore Damage Survey.* Toronto, Ontario.

Environment Canada/Ontario Ministry of Natural Resources. 1981. *Canada-Ontario Great Lakes Shore Management Guide.* Toronto, Ontario.

Feldmann, J.H. and McCrea, M. 1978. 'Evaluating the Effectiveness of CZM Programs'. In *Proceedings of Coastal Zone '78:* 117-128.

Geomatics International Inc. 1992. *Great Lakes Shoreline Classification and Mapping Study: Canadian Side.* Windsor, Ontario: International Joint Commission.

Hildebrand, L.P. 1989. *Canada's Experience with Coastal Zone Management.* Halifax: The Oceans Institute.

Hite, J.C. and Stepp, J.M. 1971. *Coastal Zone Resource Management.* New York: Praeger Publishers.

International Joint Commission. 1978. *The Ecosystem Approach: Scope and Implications of an Ecosystem Approach to Transboundary Problems in the Great Lakes Basin.* Great Lakes Research Advisory Board, Windsor, Ontario.

International Joint Commission. 1989. *Living with the Lakes: Challenges and Opportunities.* Levels Reference Study Progress Report, Windsor, Ontario.

_____. 1993. *Methods of Alleviating the Adverse Consequences of Fluctuating Water Levels in the Great Lakes-St. Lawrence River Basin.* Ottawa, Ontario.

_____. 1994. *Seventh Biennial Report on Great Lakes Water Quality.* Ottawa, Ontario.

Kreutzwiser, R.D. 1987. 'Managing the Great Lakes Shoreline Hazard'. *Journal of Soil and Water Conservation* 42(3): 150-154.

Kreutzwiser, R.D. and Slaats, M.J. (1994). 'The utility of evaluation research to land use regulations: the case of

Ontario shoreline development'. *Applied Geography* 14: 169-181.

Lawrence, P.L. and Nelson, J.G. (editors) (1993). *Managing the Great Lakes Shoreline: Experiences and Opportunities.* Occasional Paper # 21, Heritage Resources Centre, University of Waterloo, Waterloo, Ontario.

_____. 1994. *Shoreline Flooding and Erosion Hazards in the Long Point Area.* Long Point Environment Folio Publication Series, Working Paper # 7, J.G. Nelson and P.L. Lawrence (eds.), Heritage Resources Centre, University of Waterloo, Waterloo, Ontario.

Lee, B.J., Reiger, H.A., and Rapport, D.J. 1982. 'Ten Ecosystem Approaches to the Planning and Management of the Great Lakes'. *Journal of Great Lakes Research* 8(3): 505-519.

Legislative Assembly of Ontario. 1994. *Bill 163: An Act to revise the Ontario Planning and Development Act and the Municipal Conflict of Interest Act, to amend the Planning Act and the Municipal Act and to amend other statues related to planning and municipal matters.* Toronto, Ontario.

Levels Reference Study Board. 1993. *Working Committee 2, Land Use and Management Final Report.* International Joint Commission, Windsor, Ontario.

McKeen, P.L. 1990. 'Shoreline Management: A Provincial Perspective'. In *Canadian Coastal Conference-Short Course on Coastal Management: Experiences, Lessons, and Needs.* National Research Council of Canada, Ottawa, Ontario: 65-82.

McKenzie, D.I. 1991. 'Shoreline Erosion on Ontario's Great Lakes'. In Mitchell, B. (ed.), *Ontario: Geographical Perspectives on Economy and Environment.* Department of Geography Publication Series No. 34, University of Waterloo, Waterloo, Ontario: 253-268.

Noble, J.B., Epting, J.T., Blumm, M.C. and Blumstein, J.G. 1978. 'Evaluating State Coastal Plans: Questions to Ask'. In *Proceedings of Coastal Zone' 78:* 101-116.

Organization for Economic Co-operation and Development. 1993. *Coastal Zone Management: Integrated Policies.* Paris.

Ontario Ministry of Environment and Energy. 1993. *Water Management on a Watershed Basis: Implementing an Ecosystem Approach.* Toronto, Ontario: Water Resources Branch.

Ontario Ministry of Municipal Affairs. 1986. *Lakeshore Capacity Study.* Toronto, Ontario: Research and Special Projects Branch.

_____. 1994. *A New Approach to Land Use Planning.* Toronto, Ontario: Communications Branch.

Ontario Ministry of Natural Resources. 1987. *Guidelines for Developing Great Lakes Shoreline Management Plans.* Toronto, Ontario: Conservation Authorities and Water Management Branch.

_____. 1990. *Draft St. Lawrence Great Lakes Shoreline Flood and Erosion Hazard Policy Statement.* Toronto, Ontario: Conservation Authorities and Water Management Branch.

_____. 1992. *Improving Planning for Ontario's Natural Resources: Discussion Paper.* Toronto, Ontario.

Ontario Select Committee on Lake Levels. 1953. *Report of the Select Committee of the Ontario Legislature on Lake Levels of the Great Lakes.* Toronto, Ontario.

Ontario Shoreline Management Review Committee. 1986. *Report of the Shoreline Review Committee to the Ministers of Natural Resources and Municipal Affairs* (McGuigan Report). Toronto, Ontario.

Rawson Academy of Aquatic Science. 1990. *Towards an Ecosystem Charter for the Great Lakes-St. Lawrence.* Ottawa, Ontario.

Royal Commission on the Future of the Toronto Waterfront. 1992. *Regeneration.* Toronto, Ontario: Queen's Printer of Ontario.

Slaats, M.J. and Kreutzwiser, R.D. 1993. ' Shoreline Development Regulations: Do they work ?'. *Journal of Soil and Water Conservation* May/June, 1993: 158-165.

Sorenson, J.C., McCreary, S.T., and Hershman, M.J. 1984. *Institutional Arrangements for Management of Coastal Resources.* Columbia: Research Planning Institute Coastal Publication.

Thomas, R.L., Vallentyne, J.R., Ogilvie, K., and Kingham, J.D. 1988. 'The Ecosystems Approach: A Strategy for the Management of Renewable Resources in the Great Lakes Basin'. In L.K. Caldwell (ed.) *Perspectives on Ecosystem Management for the Great Lakes,* Albany: State University of New York Press: 31-58.

Vallentyne, J.R. and Beeton, A.M. 1988. 'The Ecosystem Approach to Managing Human Uses and Abuses of Natural Resources in the Great Lakes Basin'. *Environmental Conservation* 15(1): 57-62.

Weller, P. 1990. *Fresh Water Seas: saving the Great Lakes.* Toronto, Ontario: Between the Lines.