URBAN FORM AND SUSTAINABLE URBAN DEVELOPMENT
AN ECOSYSTEM APPROACH TO GROWTH MANAGEMENT

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A Manuscript Report Prepared for the
The Canadian Environmental Assessment
Research Council
August 1993

Acknowledgments

The author would like to acknowledge the financial support of the Federal Environmental Assessment Review Office in conducting the research for this report. I am also indebted to Don Alexander, Bob Gibson, and Nigel Richardson whose innovative ideas on regional and environmental planning have deeply influenced the direction of this report. Finally, I would like to acknowledge the assistance of my wife, Carolyn Guillet, who, in countless ways, helped bring this manuscript to the light of day.

Dedicated to Guy Fletcher Tomalty

Executive Summary

Municipal land use planning in Canada has tended to allow incremental changes that result in regional impacts that were unforeseen and unwanted. On the other hand, environmental assessment, which is mandated to evaluate the likely impacts of land use changes, has been carried out with a narrow scope and in a sporadic way.

Arguably, one of the most environmentally destructive consequences of this planning "system" has been what is derisively called urban sprawl, or the incremental spread of urbanized areas across the regional landscape. The dispersion of our cities has been linked to increased air pollution and energy consumption from greater automobile use, the destruction of natural habitat such as wetlands and woodlots, the undermining of the farm economy, and the degradation of water quality due to runoff, in addition to social and economic ills. On the other hand, a review of the literature on sprawl versus the compact city reveals that we can not give our unqualified support to the notion of the compact city. We conclude that the ideal urban form cannot be identified in the abstract. The task at hand is to develop a planning framework with which communities can determine suitable urban form for local conditions and achieve that form through an appropriate development strategy.

Toward this end, a regional growth management framework based on ecosystem planning concepts is proposed. An overview of growth management in the Toronto region allows us to gain insight into how current growth management regimes would have to be adapted to incorporate ecosystem planning principles.

Urban Form and Sustainable Urban Development: An Ecosystem Approach To Growth Management

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Part One

1 Introduction

One of the key problems facing urban areas stems from our failure to integrate environmental protection into land use planning. With few exceptions, the land use planning process in Canada has been reactive and fragmented whereas environmental protection requires a proactive and co-ordinated approach. The regulation of land use is primarily a municipal responsibility, but environmental protection, including environmental impact assessment, has traditionally been seen as a provincial and federal responsibility. Unhappily, local planners have historically showed little interest in environmental values (Lang and Armour 1977), while provincial agencies have refused to provide them with strong guidance on this matter. As Fowler (1991: 24) puts it: "Land use decisions by local governments are daily adding to environmental damage, largely because decision makers are unaware of the many interconnections between urban land-use regulation and the ecosystem."

Municipal land use planning in Canada has tended to allow incremental changes that result in regional impacts that were unforeseen and unwanted. On the other hand, environmental assessment, which is mandated to evaluate the likely impacts of land use changes, has been carried out with a narrow scope and in a sporadic way. The key land-use decisions contained in official and sectoral plans and their amendments are invisible to the environmental assessment process. Instead, evaluation is done on a project-by-project basis and the planning context is assumed rather than assessed. Alternatives are assessed, but only in the project-specific context and in the absence of any strong policy direction from a regional plan. The long-term and global impacts of projects reviewed are rarely taken into account, and the cumulative impacts of the myriad smaller projects that escape environmental review go completely ignored. The result is better environmental planning by project proponents but little improvement in strategic planning for the environment.

Arguably, one of the most environmentally destructive consequences of this planning "system" has been what is derisively called urban sprawl, or the incremental spread of urbanized areas across the regional landscape. The dispersion of our cities has been linked to increased air pollution and energy consumption from greater automobile use, the destruction of natural habitat such as wetlands and woodlots, the undermining of the farm economy, and the degradation of water quality due to runoff, in addition to social and economic ills.

This research report explores the notion of sustainable urban development as an emerging concept in the integration of land use planning and environmental protection. The report argues that the management of urban form on a regional scale is crucial to achieving sustainable development in the urban region. Toward this end, a regional growth management framework based on ecosystem planning concepts is proposed. An overview of growth management in the Toronto region allows us to gain insight into how current growth management regimes would have to be adapted to incorporate ecosystem planning principles.

Method and Scope of the Research

This report is divided into two parts: The first part deals with urban form from a normative perspective: what is the ideal city form from an environmental point of view? The second part deals with urban form from a procedural point of view: how can the preferred urban form be realized in practice in a concrete planning situation? The connecting link between the two parts is the notion of sustainable urban development: part one follows a line of thought that identifies one component of sustainable urban development while part two explores ways this aspect of sustainable urban development can be implemented in a concrete planning situation.

No single report could deal with these issues as a whole without remaining at a very abstract level, an unfortunate characteristic of much of the writing on planning for sustainable development. In order to penetrate to the operational level, part one of this report uses an analytic-synthetic technique. This method resolves issues into their component parts through conceptual analysis, pursues one of those components, which in turn is analyzed and so on until

an operation level of detail is achieved. The method assumes that other components ignored here could be pursued in a longer report or by other researchers and the results assembled or synthesized.

The analytic trajectory of this part is as follows: The notion of sustainable development is introduced and the special case of sustainable urban development is distinguished from it. Definitions of sustainable urban development are identified and one is pursued linking environment to the built form of the urban region. The built form is analyzed into various components including urban form which is identified as a key determinant of the sustainability of the urban region. One urban form, namely the compact city, is described as environmentally superior to other forms, but not without reservation. It is concluded that the ideal urban form is a matter to be determined under local conditions.

In the second part of this report, a planning framework for identifying and implementing a more sustainable urban form in a given locale is elaborated. We begin here with planning concepts that have recently emerged in connection with sustainable urban development, which are in turn related to urban form and operationalized to a point where they would be useful for guiding planning practice. This ideal planning framework is then used to evaluate and recommend changes to an existing growth management exercise in the Toronto region.

The analytic method outlined above requires the successive narrowing of the scope of research in order to achieve concrete results. The weakness of this approach is, of course, that much that is of great importance and interest to the general topic (achieving sustainable development in urban areas) must be shed as the analysis moves along. In most cases, this will be apparent as the report proceeds and requires no further justification or explanation. In one case, however, a few notes may be in order.

The scope of the research is confined to the environmental effects of development, although social and economic effects are alluded to where necessary. This is not done because the author believes social and economic effects of development decisions can be segregated from environmental effects, but because of limitations in time and space. The extension of the model presented here to social and economic dimensions would be a greatly more complicated (and useful) undertaking. It is hoped that the present research along the one dimension will provide some guidance for those who wish to explore this topic in its fullness.

2 A New Planning Paradigm: Sustainable Urban Development

The concept of applying sustainable development to an urban context has been slow to catch on in Canada and elsewhere — whether it be with planners and policy makers or the broader environmental movement.The early literature on sustainable development focused on non-urban systems and on resource issues in particular. Indeed, when the notion of sustainable development was first popularized by the 1981 World Conservation Strategy, its treatment of the concept completely by-passed urban areas (IUCN 1980).

While the Brundtland report continued the focus on resource issues, it also signalled the application of sustainable development to land use and urban issues by including a chapter on "The Urban Challenge" (WCED 1987). However, this treatment was largely in the context of Third World mega-cities, and "though [the Report] made reference to urban phenomena in advanced industrialized countries, it did not provide the policy framework or conceptual tools necessary to relate sustainable development to practical urban policy making properly" (Wichern 1990: 75).

At any rate, the response of Canadian governments to the Brundtland report, formulated by the Council of Resource and Environment Ministers, managed to avoid urban issues altogether (although it boasted a nice picture of Toronto) (NTFEE 1988). The official response of the Canadian Environmental Advisory Committee to the Brundtland report made only passing reference to "the sustainability of the urban environment and of the urban economy" (CEAC 1987: 56). Finally, the federal government's Green Plan, released in 1990 and inspired by the notion of sustainable development, focused on the traditional resource issues: cities were completely overlooked.

The preoccupation with the sustainability of resource development on the policy level was mirrored in the academic and professional literature. Much progress was made in applying the concept to forestry, agriculture , fishing, mining, and so on, but this work was of little help to those trying to understand how to make urban systems more sustainable. As Gariepy et al. (1990: 26) pointed out "it is undoubtedly more difficult to deal with the issue of ecological integrity when one is located in downtown Montreal than when one is in a tropical forest which is in the process of being fragmented."

Towards the end of the 1980s, some Canadian commentators had begun to remark on the need to adapt the concept of sustainable development to urban areas (e.g., Environment Council of Alberta 1988). This was based on three general observations:

- In one of the most highly urbanized societies in the world, we could hardly achieve sustainable development without dealing with urban areas.
- Local government is largely responsible for the quality of everyday life and meeting our basic needs. It is also the most responsive to citizen concern for the environment.
- Cities are where most resources are transformed into finished products and consumed. They are also the prime locus for the generation of waste and other pollutants that impact non-urban areas. Therefore a concern for sustainable resource use can not be divorced from urban issues.

In the last few years, the situation has changed considerably. Key initiatives have been undertaken at all levels of government, in universities and non-governmental organizations. At the national level, for instance, sustainable urban development initiatives include:

- a workshop on sustainable planning held by the Canadian Institute of Planners (CIP 1990)
- a catalogue of sustainable urban development initiatives in large urban areas across Canada, published by the Intergovernmental Committee on Urban and Regional Research (Maclaren 1992)
- research initiatives commissioned by the Canadian Environmental Assessment Research Council (Colnett 1991) and the Federal Environmental Assessment Review Office (Davies 1991)
- the CMHC's published research on sustainable development, housing, and community planning (D'Amour 1991, 1993).

- creation of an urban information project within Environment Canada's State of the Environment Reporting Office (Environment Canada 1992).

So remarkable has been the growth in interest in sustainable urban development that by 1992, the compilers of a "select" bibliography on the subject could claim that although there were 400 items included there, "by no means does it encompass the entirety of the relevant literature, which continues to grow apace" (Beavis and Patterson 1992: iv).

Defining sustainable urban development

Although the literature that has emerged on sustainable urban development is impressive, the concept has not achieved a fixed meaning or theoretical content. There are at least three distinct uses of the term to be found in the planning, policy, academic and advocacy literature: those that equate sustainable urban development with environmental policies and initiatives taking place in urban areas; those that attempt to link environment to development policy and land use; and those that link environment to wider community goals.

Sustainable urban development as Environmental Policy

Sustainable urban development is conceived by some as a species of environmental protection policy. Such an approach includes any practice or policy that has a positive effect on the urban environment. This would include combating indoor air pollution, switching from gas to propane powered vehicles, changes in the building code that reduce energy consumption in buildings, using salt substitutes on roads, planting trees in public parks, reducing the use of pesticides, purchasing recycled paper products, and so on. Thus, it is a catch-all approach that is appropriate for broad overviews of environmental performance in urban areas (Maclaren 1992). There is no attempt to relate environmental issues to other community issues such as social justice or economic development, or to integrate environmental protection into a theoretical understanding of urban development.

Sustainable urban development as development policy

This approach to sustainable urban development focuses on the connection between development and environment concerns (Breheny 1990a). In the urban context, development refers to the creation and preservation of the built environment. In 1989, a CEAC report defined sustainable urban development:

> *as a process of change in the built environment which fosters economic development while conserving resources and promoting the health of the individual, the community and the ecosystem (Richardson 1989: 14).*

The concept of the built environment is a very broad one; it includes the entire human-made "physical plant" of the urban system and the functions to which it is put. According to this view, sustainable development implies a major shift in land use policy, not environmental policy. Writers in this vein may dismiss the environmental protection approach for focusing on the "downstream end" of the development process, for taking development as a given and trying to minimize impacts after the fact. Sustainable development, on the other hand, minimizes the need for clean-up and mitigation because it envisions a modified development process such that environmental problems do not arise (at least with such severity) in the first place (Roseland 1991).

As Fowler (1991: 26) has remarked:

> *the central role **of** local governments is the protection, servicing and regulation of **property.** When local officials talk about what they are doing to support the environment, they point to recycling programmes, tree plantings and banning chlorofluorocarbons. And while such policies are significant, they ignore the basic patterns of land use which must be changed before our cities can be ecologically sensible settlements.*

Sustainable urban development as community development

If the first approach to sustainable urban development is narrowly focused on environmental policy, the third approach is exceedingly broad. Writers in this vein link environmental issues

with broader community concerns of social equity, community self-reliance, public participation in the decision-making process, personal empowerment, and even spiritual fulfillment (Nozick 1992).

A workshop at U.B.C. on "Planning for Sustainable Development" defined what it called sustainable community development as:

> *development which guarantees the future of the community. It creates a community that is healthy and caring, one that is socially and environmentally stable. It emphasizes the potential of human intelligence and creativity to find ways of meeting the long term economic and social objectives of the community within the constraints imposed by the biophysical environment and the demands of human decency (Reese 1989: 49).*

Advocates of this approach are likely to dismiss the second approach as too technocratic and overly concerned with institutional processes:

> *The essence of any development - sustainable or not - is not* ***in program*** *or policies or even institutions, although all of these are necessary. It is in the lives of ordinary people working together for some common goal (Pell and Wismer 1990: 6).*

Because this approach encourages making connections between environmental issues and broader social and economic issues, it appeals to community activists as a coalition-building program. However, the connections between environmental issues on the one hand and social and economic issues on the other hand go largely untheorized. Community goals are simply presented as a list of objectives or principles and little attention is paid to the necessary connections or potential conflict among such goals. The approach suffers, therefore, from assuming that these various policy objectives are mutually supportive or reinforcing, when in fact this may be far from the case.

Approach of this report

The approach to sustainable urban development employed in this report is a variation of the second approach described above. We narrow the focus here from the built environment to urban form as a key determinant of the sustainability of urban regions. Urban form is used here to mean the pattern of settlement on the regional landscape, including the structure or degree of centralization, the mix of land uses especially between residential and employment, and the density of settlement (Audirac et al 1990). Because residential land use is the predominant spatial element comprising the urban form, most of our discussion will focus on housing and related issues. On the other hand, while places of employment consume less space, the location of jobs relative to housing is an important determinant of the sustainability of the urban system and will be discussed in this context. Thus, we define sustainable urban development as:

> the process of urban development, the form that development takes and the environmental impacts it has. Sustainable urban development can therefore be defined as an environmentally sensitive development strategy for an urban region. Development here means a process of change that gives rise to the urban form of the region — the structure of the urban region, the mix of land uses, and the density of settlement.

It is important to note that while this perspective focuses on the relationship between land use and environment, it does not ignore wider community issues. Like the third approach, this approach retains an interest in community and human needs, but focuses on the mediating effects of urban form (see Figure 1). Urban form arises out of the interaction between the natural setting and the drive to meet human needs through the development process, lifestyle choices, and public policy. In turn, urban form is a key determinant of the ecological soundness of the urban system and its economic and social viability.

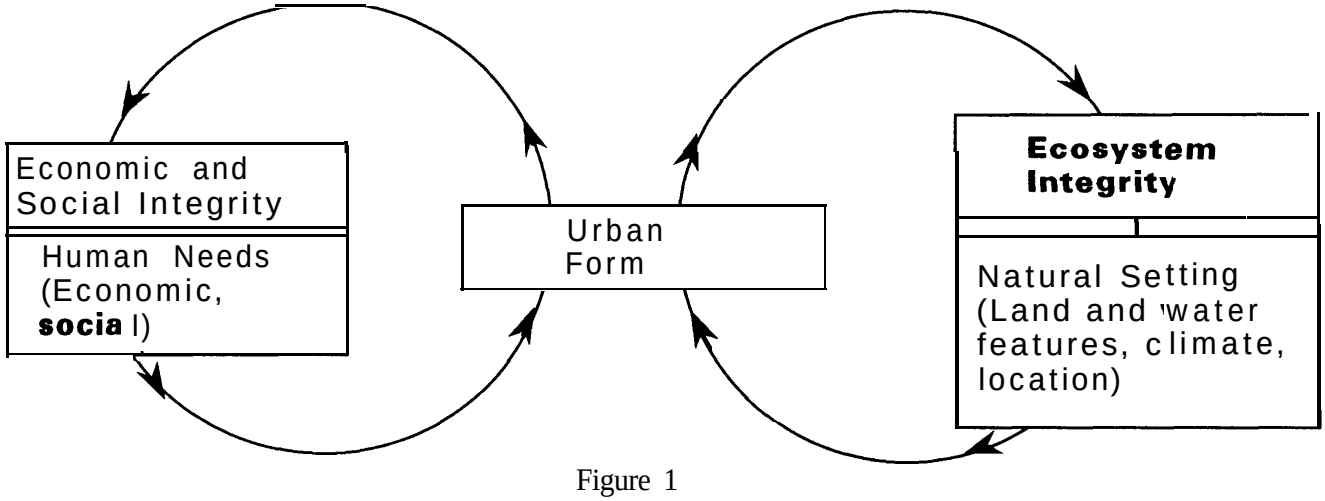
Economic and
Social Integrity
Human Needs
(Economic,
social)
Urban
Form
Ecosystem
Integrity
Natural Setting
(Land and water
features, climate,
location)

Figure 1

3 Urban form and sustainable urban development

Needless to say, the concern with the form of the city and how it affects our environment is not new. Indeed, the search for the ideal urban form has been a recurring concept in reform movements and utopian visions for at least a hundred years. As Sherri Olson (1991: 251) notes:

> ***The swift growth of the nineteenth-century metropolis produced monstrous problems. As we shall see, the concentration of built capital, and the haste to accumulate more, generated threats to health on an unprecedented scale. Concern about these threats led to new ideas, and by the turn of the century reformers had blueprints ready for a revolution in urban form. They saw congestion as the problem, and envisioned cheaper, faster transportation as the solution. Greater mobility would permit a more generous use of space, so that city-dwellers could 'breath' again.***

Over the last one hundred years, Canada's urban population has increased almost lo-fold, from less than 2 million to 19.4 million. Over this time, and especially in the last forty years, two major settlement tendencies have emerged: a greater proportion of people are living in urban regions but these regions are becoming progressively less concentrated on the urban centre.

The environmental effects of such tendencies are becoming well known. These include:

- Land consumption: Some ***60%*** of Canada's housing stock is made up of single-family detached dwelling units. Since these dwellings are usually incorporated into development patterns which are much less dense than those normally associated with other housing forms, they typically require much more land to accommodate any given population. For example, at an average of 45 persons per net hectare, single-family detached homes normally house some 58% less people per net hectare than rowhouses (at an average of 108 persons per net hectare); approximately 71% less people than walk-up apartments (at an average of 156 persons per net hectare); and anywhere from 76% to 97% less people per net hectare than high density, multi-family housing. In all, residential land uses (predominantly suburban) consume over 50% of the total area of typical Canadian cities. Along with the miles of roads necessitated by these development patterns and the auto-oriented shopping malls they tend to encourage, our living arrangements easily account for over 70% of land use shares in Canadian cities (D'Amour1991).
- Destruction of habitat and farmland: Because cities were often originally located so as to exploit an agricultural hinterland, urban deconcentration tends to consume high quality agricultural land. Thus Warren et al. (Warren 1989) have found that in the 20 years of urban growth from 1966 to 1986, large Canadian cities spread chiefly onto agricultural land: of the 301,440 hectares of rural land urbanized, 58% was of high agricultural capability.
- Energy consumption: According to Sanderson and Wolfe (1978) Canada has the highest per capita use of energy in the world. The heavy demand for fuels is attributable not so much to the cold climate as to the form of Canadian cities - the way they spread over the landscape. Half the energy used by the average urban household is used for driving cars. Sweden, with a comparable living standard, uses only three-fifths as much energy per person. The National Energy Board (1986) estimates that operating the existing stock of housing accounts for over 20% of the nation's total energy demand, a figure that does not include the extra embodied energy associated with single detached houses, which require up to four times more infrastructure per unit than duplexes (D'Amour 1991).
- Groundwater pollution: The deconcentration of urban populations has given rise to an extensive urban-rural fringe based on septic systems. In Ontario alone, there are now close to one million septic systems installed, many of them in poor condition. Health officials estimate that 30% of septics in Ontario are failing, contaminating drinking water and exposing the public to health hazards (Silversides 199 1).
- Stormwater runoff: Urbanized areas are generally covered by hard surfaces that inhibit the percolation of rainwater into the soil. Instead runoff is directed into the storm sewer system and usually discharged untreated into the receiving body of water. Such water is a major source of

toxic metals, chlorinated organic compounds, and other serious pollutants (Environment Canada 1991a).

- Wetland destruction: Wetland areas in the vicinity of major cities have been greatly reduced as a result of urban growth. Since 1950, wetlands have been steadily dredged, drained, and filled for port, industrial, and airport use, waste disposal, and urban growth in general. By 1981, up to 98% of the wetlands in the Regina, Winnipeg, and Windsor areas, 88% in the vicinity of Toronto and Montreal, and nearly 78% in the Vancouver, Calgary and St. Catherine's_Niagara Falls areas had been converted to other uses (Environment Canada 1991a).
- Materials use and waste production: About 20% of the waste going to landfills in Canada is generated by construction activity. New construction on the urban fringe is a major contributor to this flow. Materials used for urban infrastructure (such as roadways, sewer and water lines and storm sewers) vary inversely with the density of housing. Once occupied, single-family housing tends to produce more waste and the low-densities of new suburban areas may inhibit the establishment of blue box recycling programs (Paehlke 1991).

Compact urban form

The sprawled city has produced a "counter-revolution" in thinking about desirable urban forms. Over the last several years, many planning, policy and advocacy documents have proclaimed an "emerging consensus" that cities must pursue new patterns of development that will result in a more compact urban form.

In Canada alone, the number of reports that have adopted this model is astonishing.1 This "consensus" is composed of a three part package of interlinked concepts: a densely settled urban form; the functional mix of uses; and a public transit system to connect form and function.2 Lang and Armour (1982) provide a typical vision of a more compact urban form:

> *The settlement is compact. Little urban sprawl, strip development or underutilized land exist, the result of infilling and development controls. Nor does the settlement spread into its hinterland's agricultural areas and forests, which are seen as valuable energy resources.*
>
> *Places of work, residence, shopping and recreation are well related to each other and to the transportation system, and people choose to take advantage of them rather than making long automobile trips. Population densities in most parts of the community are sufficiently high to make transit feasible; it is also convenient, efficient and heavily used. Clustered along transit corridors and in the settlement's several centres are complexes that mix a wide range of activities for mutual advantage.*

Environmental benefits of the compact city

A review of the research on the environmental effects of urban form suggests many advantages to the compact city. What follows are some of the main arguments put forward by the advocates of a more compact urban form, citing available research.

Compact urban form reduces the need for motorized transportation

Passenger transportation energy can be reduced in two ways: by making cars more efficient, and by making urban structures more efficient. Goldstein et al. (1990) argue that both approaches are feasible, and present evidence showing that each could realistically produce a 30% or greater reduction in transportation energy consumption over the next 30 years. Holtzclas (1991) compares vehicle miles travelled per capita and per household for San Francisco, Chicago, New York, London, Toronto and elsewhere. The results show a consistent pattern: Doubling

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1 Examples include: Fowler 1(991), Pianosi (1991), Fulford (1993), the Ontario Round Table (1991), Alberta's Environment Council (1988), D'Amour, 1991, 1993.

2 This framework is adapted from Vance Jr. (1990) who has proposed an analytic framework of *form*, *function*, and *connectivity*.

residential or population density reduces the annual auto mileage per capita or per household by 20-30%.

If vehicle use is reduced, air quality will improve

Automobiles are responsible for over 40% of all air pollution (Brown and Jacobson 1987). Downing and Gustely (1977) found that air pollution from automobiles was 20-30% less in a more compact planned community than in an unplanned sprawled development.

Higher densities enable more viable public transportation

A widely-cited study by Newman and Kenworthy (1989) on transportation and density in 32 world cities shows the direct relationship between density, viability of public transit systems, and automotive fuel usage. Along the same lines, Goldstein et al. (1990) conclude that areas that are built to high density will not function effectively without transit service, and will provide an excellent market for the establishment of such service. Pucher (1988) compared urban transportation systems and travel behaviour in 12 Western European and North American countries. He found that the success of public transportation depends more on supportive urban development and automobile taxation policies than on transit subsidies.

Higher densities enhance the potential for walking and cycling

Patterson (1992) looked at eight Canadian cities and compared place of residence, place of work and mode of transport to work. He concluded that higher densities and the greater proximity of home and work are required if the choice of mode of travel to work is to become more environmentally friendly or healthier.

The compact city reduces the cost of environmentally friendly services

Paehlke (1989) claims that higher density settlements are better able to afford recycling programs, such as waste collection, facilities recovering waste materials, the marketing of waste materials, and the control and treatment of effluents and other forms of pollution. This argument is reinforced by Richardson (1991) who argues that many of the environmental impacts usually associated with the city are in fact the attributes of particular activities which happen to seek urban locations, or whose effects are locally magnified by their intensity in an urban location. These impacts may be more economically and effectively managed if the sources are concentrated than if they are dispersed.

Smaller living units and multiple dwellings are more efficient in terms of energy and materials use

Owens (1986) found that heat energy is more than 20% more efficient in semi-detached houses and nearly 30% more efficient in rowhouses than in comparably insulated single-family dwellings. A mid-floor apartment requires about one-third the heat energy of a detached house of equivalent size. She also argued that high density makes district heating feasible. In another study, Downing and Gustely (1977) found that in high density areas, energy consumption from auto transport, space heating and cooling requirements were more than 40% lower than in low density residential developments. Water consumption was reduced by approximately 35% in high density communities. A 1985 study in Sault Ste. Marie found that semi-detached and townhouse units consume an average of 66,400 MJ/unit annually, and that apartments consume 33,200 MJ/unit annually. These figures were 20% and 60% less respectively than detached units, which consumed 83,000 MJ/unit annually (Lang 1985).

More densely settled cities allow more efficient heating systems

D'Amour (1993) has drawn attention to the potential for higher density areas to use cogeneration and district heating. Both are highly efficient in the delivery of space heating to households, a use which accounts for 67% of all residential energy consumption. He cites a detailed study in the UK, which suggested minimum housing densities of about 44 units per hectare before cogeneration and district heating can be a viable alternative. The average density of much of Canada's single-family housing is only 10-15 units per hectare. Thus, these possibilities remain largely untapped in Canada.

Compact cities reduce energy and materials used for infrastructure and utilities

One of the most widely cited works on this topic is the Real Estate Research Corporation's The Costs of Sprawl **(1974).** The study examined the infrastructural demands - including sewers, water supply, and storm drainage - of various development patterns. The authors found that more compact development requires less infrastructure than sprawled development. Witold Rybczynski (1991), who co-developed the Grow Home concept, has pointed out that a modest one-storey single-family house typically needs a sixty-foot-wide lot, i.e., each house requires sixty feet of roadway, sewer and water line, and storm sewer. A narrower, two-storey cottage can be built on a forty-foot-wide lot, immediately reducing these costs by a third. A semi-detached house requires even less frontage; thirty feet. Row houses, which can be built on twenty-foot-wide lots, have a more dramatic impact on land cost and infrastructure cost is reduced by two thirds. A study conducted by the Ontario Ministry of Municipal Affairs (1982) found that higher density designs made it possible to save more than 40% of capital energy (energy that goes into creating hard services) that typically goes into the servicing of a conventional design.

Environmental risks of the compact city

Thus, the academic literature provides some impressive empirical support for the compact city as an ideal urban form from an environmental perspective. Not surprisingly, some planners have concluded that "[i]ntensification is a requirement rather than an option in devising appropriate plans for future development of urban areas" (Pianosi 1991: 47). However, before adopting this as a universal response to the evils of sprawl, we should have a clear understanding of the issues involved and the efficacy of the available responses. For this purpose, we turn our attention to the considerable body of research that takes issue with the compact city model. These arguments may be divided into two sections: those that marshal evidence to dispute the claims made for the environmental benefits of the compact city, and those that point out potentially negative environmental impacts of a compact city form.

Disputing the claims of the compact city

The connection between public transit and higher densities is not as straightforward as proponents of intensification assert

Webster et al. (1985) examine the reasons for the different trends in use of urban public transport in different OECD countries. They conclude that private car use will continue to be the primary mode of transportation and that transport and land use policies seem capable of exerting only a relatively weak influence on the prevailing trends in urban structure and transport choice. Rather, they attribute changes in urban form to strong long-term economic and social forces which are present in all countries.

Altshuler et al. (1979) examine the consequences of transportation decisions on land use development. They maintain that transit improvement policies and land use controls can support central-area development but do not induce it. This conclusion is supported by Harrison (1976) who claims that the perception of the ability of public transportation to encourage more dense development patterns is not empirically justified.

The energy benefits of a higher density urban form are exaggerated

Altshuler (1977) criticized the 1974 Real Estate Research Corporation study charging that it overestimated the environmental impacts and energy consumption levels of low-density communities. Altshuler pointed out that different total floor areas were assumed for the various communities and that estimates for energy consumption were based on the number of trips made locally, which constitute only 20% of annual household auto mileage. In addition, some assumptions made concerning the substitution of mass transit for automobile use were not empirically supported. Windsor (1979) provided empirical support for Altshuler's study.

Likewise, the US Department of Housing and Urban Development (1980) has stated that the energy conservation associated with high density land use is realizable only in the long run. In the short run, conservation benefits can be achieved by regulating automobile use, enhancing structural thermal efficiency and by increasing energy prices, rather than changing urban form.

Intensification will not substantially reduce the amount of land used for development

Troy (1992) argues that proponents of intensification exaggerate the amount of land used for residential development and the potential land savings from intensification. In Australia for **instance,** the actual average lot size for new development is about 700 square metres, only two thirds the size repeatedly claimed by intensification proponents. Because only a small proportion of urban land is used for residential purposes, implausible increases in residential density would be necessary to achieve even modest savings in land and infrastructure demands.

Sprawl is only inefficient in cities with a single centre. In polycentric cities, sprawl may actually reduce trip length and congestion and therefore reduce fuel consumption

The argument that urban sprawl is environmentally costly generally assumes a monocentric model of urban development whereby travel distances increase as urban growth extends from the centre. Gordon and Wong (1985) counter this model with a polycentric model, which states that trip-destinations (especially for work trips) become more dispersed as cities grow and that this development is in many ways more efficient. To test for this, the authors used a national sample from the US 1977 Nationwide Personal Transportation Study. They conclude that dispersed work trip-destinations have allowed for shorter work-trip distances for suburban residents in the largest cities.

In a later paper, Gordon and Richardson (1989) argue that as urban growth continues, the monocentric city becomes inefficient due to increasing congestion costs in the core, and that as a result, a polycentric urban structure emerges. They found that dispersed and polycentric metropolitan areas facilitate shorter commuting times.

The US Department of Housing and Urban Development (1980) has analyzed the impact of metropolitan development patterns on the achievement of economic and environmental goals. Data were collected for 106 metropolitan areas. The report found that the reduction in miles travelled as a result of increased density and diversity only applied to large and medium-sized metropolitan areas with large concentrations of jobs in the central business districts and mass transit systems. No broad relationships between travel behaviour and densities were found in small metropolitan areas.

A free market at the urban fringe may lead to higher densities than with interventionist land policies in favour of a compact urban form

The assumption behind a compact form policy is that the private land market is unable to achieve optimum densities and land use patterns without public intervention. While there is a consensus that land markets do fail to achieve satisfactory land uses in certain respects, (Hallet 1988) public intervention may have perverse effects and fail to improve or worsen the situation (Lee 1981). Some researchers have argued that this is just the case with policies meant to prevent the spread of urbanized areas. They present evidence that a free land market at the outskirts of urbanized areas will result in more efficient land use patterns than where controls are imposed (Ottensmann 1989).

Mills (1981) presents an economic theory of sprawl in a growing, monocentric city. He concludes that criticisms of leapfrog development are myopic: There should be no reason to expect that efficiency in urban land conversion should be marked by spatial continuity; rather, in a growing city efficiency requires that some parcels be withheld from early development.

Peiser (1989) argues that sprawl will actually promote higher densities in the long run. Analysis of the empirical data demonstrates that densities increase over time when accessibility improves in almost all distance zones. He suggests that a freely functioning land market will opt for its natural densities, within the limits of the existing levels of public services, through the process of urban sprawl; that is, noncontinuous development followed by infill development.

"Sprawl" is not a precise enough concept around which to structure a meaningful debate

The discourse promoting the compact city tends to cast the issue as pitting sprawl versus compact form. There is, however, no accepted definition of sprawl per se, and it is of questionable usefulness in policy terms.

Bahl and McGuire (1974) have identified at least three different types of sprawl:

- low density, continuous development which is merely the "gluttonous use of land in opposition to a value judgment about a higher density which would have been more appropriate" (quoting Harvey and Clark, 1965).
- ribbon development which is an axial extension from previous development, such as that which occurs along a highway.
- leapfrog development, or development usually separated from the urban area by some amount of idle or unused land.

Many researchers make a distinction between the "natural" growth of the urbanized area and sprawl. Bourne (1975:6), for instance, decries the misuse of the word sprawl:

> *[U]rban sprawl is a very different phenomenon from that of a well-planned, orderly extension of the suburban margin of a growing city. Most Canadian cities have both. Unfortunately both are frequently lumped together in discussing the options for redistributing new growth. What we need to do is to identify what quantity and quality of growth is necessary and then to seek ways of accommodating or redirecting it in desired directions. Even planned suburban extensions are not desirable if allowed to continue at an excessive rate, or indefinitely, or if permitted to destroy critical environmental resources in the process. New suburban growth is, however, preferable to a rapid escalation in land costs, severe housing shortages and social frustration.*

There is no consensus on the ideal compact form

The compact city may refer to the pattern of settlement on a regional, sub-regional or local scale. Various researchers in this field have identified a myriad of compact urban forms having various environmental impact characteristics (and different social and economic implications). At the regional level, Preston (1977), for instance, identifies two ideal forms: "multiple centres" and "radial corridors". Likewise, Rickaby (1987) has explored inter-urban forms from an energy point of view and recommends "centralization" into a compact high density city or "decentralized concentration" with separate concentrated sub-centers around existing large cities.

Working at the sub-regional or intra-urban level, Owens (1986) suggests two more compact forms: an "archipelago" pattern, made up of self-sufficient urban sub-units of about 10,000 to 30,000 people and "linear grid" structure focusing development on a small number of routes, a pattern that would encourage public transport and communal heat and power systems with the "holes" in the grid allowing the use of solar energy. On the local scale, the Canadian Urban Institute (1991) has identified at least five forms of compact development: suburban densification, infill of vacant lots, conversion of single-unit to multi-unit dwellings, adaptive re-use of existing non-residential buildings or the redevelopment of land.

Negative Impacts of the Compact City

Densely settled cities will mean less green space and wildlife habitat but more stormwater runoff and water pollution

Striving for more compact urban forms may put pressure on planning authorities to allow green and open space in already built up areas to be converted to residential use. This would reduce wildlife habitat while increasing stormwater runoff and discharge into water bodies. If intensification also leads to greater congestion, then runoff toxicity will be increased from vehicle exhaust and drippings (Nichols 1987; Audirac 1990)

Air quality may be adversely affected by intensification

Naroff and Ostro (1982) have argued that high-density, core-oriented cities have higher levels of mobile- and stationary-source pollutants than dispersed cities. The authors present the results of a

model devised to determine the degree to which the concentration and dispersion of jobs and population would change the level of pollution in the central city. Results suggest that the **population** dispersal from 1960 to 1970 was associated with a 2.0% reduction in nitrous oxides and a 0.5% reduction in pollution concentration. Likewise, the US Department of Housing and Urban Development (1980) found that low-density, dispersed development patterns separating residential areas from sources of pollution attain better urban air quality than do mixed-use patterns.

Urban constraint policies may have little effect on farmland preservation but may undermine the farm economy

Richardson (1991) has pointed out that physical urban expansion eliminates only a small proportion of the stock of good agricultural land, hence the difference made by intensification in this respect would be negligible.

The concentration of population in compact cities may, ironically, serve to undermine the rural farm economy by depriving farmers of economic activity that could have sustained them; the right to severe and sell parcels of their land. At least two authors have argued this case as applied to urban containment policies in Britain (Newby 1990; Breheny 1991b).

Densely settled cities are less able to exploit renewable energy and are prone to energy-consuming congestion

A compact city form may interfere with the exploitation of renewable energy sources (Ward 1990). Most renewable forms of energy - including solar energy, wind and tidal power - can best be utilized in small packets in a dispersed settlement form. High density urban areas tend to be congested and slow moving traffic causes very high fuel consumption. La Barra and Rickaby (1987) have shown that fuel consumption at 15 km/hour, the average speed in central London, is about 3040% higher per kilometre than at suburban speeds of 40 km/hr.

Conclusions

A casual reader of the planning, policy and advocacy literature associated with compact urban form could be forgiven for concluding that there is a solid consensus in favour of a compact urban form and that this a well-defined model towards which any given urban area may strive. Our review of the substantive and theoretical problems with compact urban form as a policy objective indicates that this is far from the case. In fact, opinions are highly polarized as to the coherence, wisdom and efficacy of such a policy. Owens - herself a champion of more compact forms - has dismissed the more extreme views in favour of high density cities by saying: “Quite apart from the serious questions that could be raised about the flexibility and sociological implications of such a form, its apparent energy advantages do not stand up to detailed scrutiny” (1986: 62).

Thus, while the notion of promoting more compact cities has an intuitive attractiveness to it, we should not be blind advocates of it. We have seen that:

- there are serious substantive complications with the compact city and that precautions need to be taken if the benefits of intensification are to be realized without incurring its potential costs
- the discussion of sprawl versus intensification needs to be carried out at a more concrete level than is evident in the advocacy literature
- a policy of achieving a compact urban form may only be beneficial in urban regions that have certain previously existing characteristics.

We conclude that the ideal urban form cannot be identified in the abstract. The task at hand is to develop a planning framework with which communities can determine the most suitable urban form for local conditions and achieve that form through an appropriate development **strategy.** Toward this end, we turn now to proposing a regional growth management framework based on ecosystem planning concepts.

Part Two

4 Re-forming the Citv: An ecosystem planning framework for growth management

> *There is little evidence, from either North America or Europe, that there exists the institutions or the techniques to deal with the larger land use and planning needs of the spread city.*
>
> *- Kivell, 1993: 189.*

Much of the discussion of urban form has tended to focus on idealized forms and their social, economic and environmental implications. Most planning, however, does not take place on a blank regional landscape where planners (or others) can create an urban form from scratch. On the contrary, the most important land use decisions have to be made in the context of an already urbanized area and concern the continued development of that area: Should growth continue? If so, where should it take place; on the urban fringe or in the core area? What type of growth is desirable (single-family housing, affordable housing, housing for seniors)? How will the infrastructure be financed? How can environmental effects be minimized? Achieving a preferred urban form in practice means managing growth in the urban region.3

Environmental assessment and land use planning

There are two institutional processes that are available for the environmental management of land use and development: environmental assessment and land use planning. Both systems have mandates to control land use as an instrument of environmental protection, both precede land use decision-making and "share the goal of broadening and improving decision-making beyond a narrow technical and economic agenda of considerations" (Lawrence, *1992: 22).* Despite these similarities, they are the products of separate legislative evolution, and are carried out in virtual isolation from one another.

A growing number of planning professionals and advocate groups are calling for the integration of these two planning processes (Marshall et al. *1985;* EAAC 1991, 1992; Lang and Armour 1977; Brugmann 1991; Richardson 1993) Two broad possibilities present themselves: environmental assessment of land use planning or environmental assessment in land use planning. Although the potential of the first approach - which involves submitting land use plans for formal environmental assessment - deserves further research, it is usually considered to be too complicated an undertaking to be practicable (Wood 1988; EEAC 1991). Here we consider the second approach of incorporating the principles of environmental assessment into the land use planning system. The land use planning system has several strengths that make it the obvious starting point for any growth management system:

- In contrast to the environmental assessment process, which is based on a legal model that inhibits many people from participating, the practice of official - especially strategic planning - has become broadly inclusive (Dorfman 1991). It therefore can serve as a vehicle for the expression of the community interest.
- In contrast to the environmental assessment process, which usually does not apply to private sector projects, the planning system governs private undertakings and therefore is more appropriate as an instrument of development control.
- In practice, environmental assessment is reactive rather than anticipatory, and focuses on a single undertaking on a particular site. It is therefore unable to consider overall land use relationships, or influence prior decisions affecting the particular undertaking. In contrast, the

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3 This part is concerned with elaborating a planning framework, not in the specific techniques of urban growth management (such as urban growth boundary lines, maximum lot sizes, density requirements, impact fees, concurrency requirements, farmland preservation boards, and so on). On the other hand, these are all techniques that could be used in the framework developed here.

planning system is meant to provide a broad spatial and temporal framework within which individual projects can be evaluated and integrated with other land use decisions.

On the other hand, incorporating environmental principles into the land use planning process may help overcome some of the weaknesses of the planning system. In particular, environmental assessment:

- allows the consideration of alternatives to the existing proposal
- applies to specific development projects
- requires that development proponents demonstrate that their proposal is in the community interest
- applies scientific knowledge to a planning situation
- requires that existing environmental conditions be surveyed
- governs public - including provincial - undertakings

Thus, the two processes are complementary: the limitations of the one are the strengths of the other. Undoubtedly, the planning system would be substantially strengthened as an instrument of growth management through the incorporation of environmental assessment principles. Nonetheless, the resulting system of land use decision making would still have certain weaknesses:

- Land use planning is fissured in several dimensions: between government levels (vertically), between governments at the same level (horizontally), and between departments within single government jurisdictions (internally). For example, transportation planning is done by engineers at the provincial level independently of planning professionals designating land uses at the municipal level. These planners, in turn, may work in isolation from their colleagues in neighbouring jurisdictions, and from transportation planners within their own jurisdiction. This fragmentation has several consequences: a lack of integration between spatial (municipal) and sectoral (provincial) plans, and a lack of effective planning done on a regional scale where many of the environmentally strategic land use decisions must be made.
- Like environmental assessment, land use planning does not work within a framework of "overall environmental objectives, defining ecological and community sustainability goals and setting indicators for monitoring of success and failures" (Gibson 1992: 3 14).
- Traditional environmental assessment tends to focus on the immediate environmental effects of the individual project under consideration. Long-term effects, or those that are likely to arise in combination with other projects or activities are given much less importance. Likewise, the local planning process typically ignores the cumulative effects of the development undertakings permitted under official plans and permits incremental amendments without a view to the cumulative impacts that arise over a series of decisions.

An ecosystem framework has been associated with proposals to improve both the environmental assessment process (e.g., Beanlands, 1983) and the planning process (e.g., Conservation Authorities of Ontario, 1993). The ecosystem planning concept is proposed here as a way of incorporating environmental assessment principles into land use planning, while providing a mechanism for regional planning, the setting of ecological and community objectives, and the assessment of cumulative impacts. In this section, we present an ecosystem planning framework for the management of growth in an urban region. In section 5, we examine an existing regional growth management initiative (in the Toronto region) and suggest institutional changes that would allow such an approach to be implemented in a given planning context.

The urban ecosystem and the ecosystem approach to land use planning

Lynch (1981: 115) provides a justification for seeing the urban region as an ecosystem:

> *[A]n ecosystem is a set* of ***organisms*** *in a habitat, where each organism is in some relation to others of its own kind, as well as to other species and the inorganic setting. This system of relations can be considered as a whole, and has certain characteristic features of fluctuation and development, of species diversity, of intercommunication, of the cycling of nutrients, and the pass-through of energy. The concept deals with very complex systems, with change, with organic and*

inorganic elements together, and with a profusion of *actors and offorms... [A]n ecosystem seems to be close to what a settlement is.*

The term 'ecosystem' is used here to mean a subdivision of the ecosphere with boundaries that are defined according to some particular purpose (Vallentyne et al., 1988). An ecosystem is conceived as a cybernetic model connecting energy flows and sinks, nutrients and waste flows, atmospheric gases, minerals and other materials and interconnected by control elements and feedback loops (Odum 1971). The urban ecosystem includes the built environment of buildings, roads and other infrastructure, and the functioning of the urban ecosystem includes the energy and material flows through the built environment and the waste stream produced as a result.

Exline et al., (1982: 9) has recommended an ecosystem approach be adopted on the grounds that "it can be a powerful tool for describing and analyzing urban places." Indeed, some analysts (e.g., Wolman 1965) have found the concept useful because it:

- points to the importance of planning on a regional scale
- recognizes the primacy of natural boundaries and processes such as watersheds and topographical features rather than political units
- provides a framework for the monitoring and control of cumulative effects
- can be used to analyze city metabolism, the flows of energy, oxygen, materials, and waste that course through the urban area
- incorporates the concepts of carrying capacity, resilience, and sustainability, suggesting that there are limits to human activity beyond which systems break down.

In this section, we attempt to operationalize the concept of ecosystem planning by using it to develop a planning framework for growth management. The framework includes the following steps:

- define the planning region
- survey the region
- determine the development potential and limitations of the region
- identify development and ecosystem objectives
- formulate and assess alternative growth management plans
- implement the plan on regional and sub-regional levels
- monitor plan implementation

In each of the planning steps below, an attempt is made to operationalize the concepts discussed by suggesting quantitative measures and indicators of the concepts involved and sources of relevant information in Canada.

Setting the boundaries: The planning bioregion

In many urban regions in Canada, urban growth has overflowed municipal boundaries and has led to politically fragmented metropolitan areas unable to devise area-wide solutions to problems of growth (Kulisek and Price 1988). At the same time, a consensus has emerged that the problems of urban growth must be dealt with at the regional level (Gibson 1992; Colnett 1991; Rees 1988a; Peterson et al. 1987; and Sonntag et al.1987). Such analysts believe that the regional perspective is necessary in order to prevent piecemeal growth management efforts at the municipal level that merely distort development activity into less efficient and counterproductive patterns. A regional planning effort is required to ensure that infrastructure extension is efficient, that land use is co-ordinated with regional transportation planning, that the connectivity of the regional landscape is maintained for wildlife and recreation, farmland is preserved, and environment (and other) effects of land use decisions are monitored for their broader implications.

An urban region can be defined in a number of ways: political, cultural, economic, or ecological (Alexander 1993). A political region is defined by the existence of regional governments, planning boards or special purpose bodies such as utility or transportation commissions dealing with issues on a regional level. A cultural region may reflect linguistic or ethnic groupings, lifestyle-related patterns of recreational destinations, telephone use and newspaper distribution and so on. An economic definition of a region might use commuter patterns, an analysis of supplier locations to city-core industries, and patterns of trade. While

those who use the ecosystem planning model generally reject the use of political boundaries as planning units, it is less clear what role cultural and economic factors play. In the case at hand, however, we are interested in concepts that will help integrate environment and development; we will therefore focus on the ecological and economic definitions of the region.

Several authors have itemized the ecological boundary options. Environment Canada (1991) has identified the bioregion, the watershed catchment basin, and the watershed sub-basin. Alexander (1991) has identified five levels of hydrological organization that have potential relevance for planning purposes: "the creek level, the watershed level, the river basin level, the lake level (e.g., the Lake Ontario basin), and the overall basin level (e.g. the Great Lakes Basin)." Alexander agrees with Odum (1971) and Imhof (1991) that the watershed is the unit most appropriate for ecological planning. Unlike other ecologically defined boundaries such as landforms or airsheds, watershed boundaries can be precisely identified and change only very slowly.

Indeed, the watershed appears to be the unit of choice in most ecosystem planning taking place in Canada and the US (CAO 1993; USEPA 1992). On the other hand, most of this planning is occurring in rural and resource areas where the watershed unit encompasses the relevant planning variables. In urbanized regions, however, the watershed may not serve the same purpose since the urbanized area frequently spans several watersheds. The most important determinant of settlement patterns in large urban areas are the infrastructural elements that are under public control: harbours, airports, the regional transportation network, trunk sewer lines and so on. In this case, watershed-based planning would be no less fragmented than planning done on a municipal level.

Thus neither municipal nor watershed boundaries can serve as the planning unit for growth management in an urbanized region. Nor will existing regional governments serve our purposes here, having in many cases already been spatially superseded by urbanization (e.g., Toronto and Montreal). Statistical definitions such as census metropolitan areas or census agglomerations are more helpful in that they are based on the daily commuting habits into the major labour market centres, and thus reflect a key variable in regional growth management: the housing cost-transport time trade-off (Finkler et al. 1974). On the other hand, these areas do not allow for future growth of the urbanized region until it occurs (Self 1982), nor do they necessarily incorporate the regional hinterland that is expected to absorb the environmental impacts of urbanization. For these purposes, we need a planning area that anticipates long-term growth and incorporates the likely ecological pathways that sustain intense human use of the land.

In order to satisfy these requirements, we proposed here to use a multi-watershed planning unit that integrates ecological and economic dimensions: the planning bioregion. The purpose behind the bioregional concept is to "reorient human activity towards dynamic balance in nature," and "irrevocably marry human activity into processes of sustainable land, animal, plant, and atmospheric interaction." It is therefore "necessary to make human occupation of the land area a part of the bioregion definition" (Aberley 1993: 74-75).

A bioregion is defined as the geographical area bounded by natural elements that encompasses the significant economic patterns of the region (Alexander 1988). The precise boundaries of the bioregion will be determined by the participants in the growth management process, but we can review some general considerations here. Natural boundaries may involve land features, soils, vegetation, climatic patterns and so on, but in most cases, watershed boundaries will prove most convenient. The biophysical aspect of the bioregion can therefore be conceived as a series of adjacent watersheds and their hierarchies of sub-watersheds, with the outer watershed perimeters serving as the bioregional boundary.

The watersheds that are chosen for inclusion in the bioregion will depend on the economic component, which in turn will depend on the purposes to which the concept is to be put. For our purposes, we are interested in defining a region that captures the significant development pressures in the region, commuting patterns and ecological processes that serve as pathways for dispersing the environmental impacts of urban activities. It will therefore rely heavily on the commutershed, but will also include areas of likely development pressures. Whatever boundary

is chosen, it may be adjusted periodically as the commuting and development patterns of the region undergo change.

Characterizing the planning bioregion

Once the boundaries of the planning unit have been established, the current state of the bioregion needs to be surveyed in order to identify key planning issues and to provide a planning baseline. Sustainable urban development is the relationship between the human-made and the natural environment. Our survey of the planning bioregion is therefore divided into a characterization of the human-made urban form and an evaluation of the current state of the natural environment.

Urban form

In section 3 above, we defined urban form as having three elements: structure or degree of centralization, the density or intensity of land use, and the mix of land uses, especially residential and employment uses. Here we review some of the measures that may be used to characterize the planning bioregion. We focus especially on those indicators for which information is readily available through federal institutions such as Census Canada, Statistics Canada, and the Canada Housing and Mortgage Corporation.

Urban structure

The traditional city had a strong central commercial, institutional, and industrial focus around which it grew. As we saw in section 3, however, the urban region appears - in at least some areas - to be developing into a polycentric entity. Characterizing the degree to which an urban region is focused on a single city centre is crucial for growth management policies as it will affect how city "users" respond to such policies in terms of their choices in modes of transportation and housing. Bourne (1989) has developed a simple technique using journey-to-work data as an indicator of polynucleation. The method compares the number of census tracts in each urban area that received journey-to-work flows of a given size. By varying the size of the flow (e.g., 200 , 300,400, or 500 workers per day) we can observe nucleation at different employment scales. For example, at small flow sizes, the resulting map may indicate significant suburban nucleation, but at larger flows, the CBD may prove to be the more dominant.

Density of land use

Of course, the density of land use will vary over the surface of the planning bioregion. In general, densities have been found to decline as a function of distance from the urban centre. One measure that captures this relationship has been found to be a useful measure of the density pattern of urban-centred regions around the world: the density gradient (Clark 1951). The urban density gradient provides a readily grasped measure of population concentration and dispersion within urban areas (Edmonston et al. 1985). Population and land area data are collected, usually by census tract, distances from these units to a central point are computed and the best-fit negative exponential logarithm is chosen to represent the data. A "quick" method of estimating the population gradient of a planning bioregion is called the two-point estimation method, and uses two sets of relatively accessible data: the central area and the total region. The required data consists of population, land area, degrees of land area excluded from urban settlement, and the geographic shape of the urbanized area (Edmonston 1983).

Land use mix

The mix of land uses is an important dimension of urban form from a sustainable urban development perspective because it can affect the transportation patterns of the community, both in terms of the mode of transportation and the distances travelled. One measure of the balance (or imbalance) in land use is the distances that residents typically travel to get to work. Journey-to-work distances are calculated on a census tract basis and indicate the availability of work in neighbouring areas. Long distances travelled are symptomatic of homogenous residential development with few employment opportunities (Boume 1989).

Health of the urban ecosystem

The concept of ecosystem health is a medical analogy that has been applied to planning situations. "An ecological system is healthy...if it is stable and sustainable - that is, if it is active

and maintains its organization and autonomy over time and is resilient to stress" (Costanza et al. 1992: 9). Properly applied, the concept can communicate complicated ecological conditions and relationships in simple effective terms to policy makers, managers and citizens involved in the growth management process. It could provide an ecological baseline for formulating a growth management strategy and simplify monitoring of the effects of such a strategy. Typical indicators of ecosystem health are provided by Fisher (1993) who has pointed to hydrological functions, landscape connectivity, presence of indicator species, and critical habitat functions.

The ecosystem health concept is especially adapted to rural and resource situations where ecosystems are more or less intact and human stresses are relatively easy to isolate (e.g., a logging operation in a rain forest, commercial fishing in an inland lake, or the use of lake water to cool a nuclear station). While some elements of this concept can be transferred to the urban context, especially in urbanizing areas on the urban fringe, much of the work on ecosystem health indicators is of questionable use as an instrument of bioregion-wide growth management. In urbanized areas, ecosystems are considerably altered by the human-created built environment and no longer function independently from it. The hydrological functions that are partially replaced by engineered systems of water collection and distribution serve as an obvious example. Many species are already locally extinct, and critical habitats have been destroyed. Many urban ecosystems are probably beyond their natural stress thresholds and would collapse without importing raw materials and exporting waste. Under such conditions, indicators of ecosystem health developed in a rural or resource context are unlikely to be of great use in assessing the ecological health of the bioregion.

Unfortunately, a rigorous analysis of the urban ecosystem from an ecosystem health perspective has yet to be undertaken.4 and, to this author's knowledge, no local government in Canada has ever carried out. a systematic appraisal of the health of the urban ecosystem.5 As surrogate ecosystem health indicators, we will draw on the literature review presented in section 3 above, which suggested several key environmental concerns associated with the choice of urban form. These will be divided into two sections: the quality of environmental media (land, water, and air), and the quantity of energy and materials flowing through the urban ecosystem.

Environmental media quality

Land cover, biotic diversity and wildlife corridors

One of the principle cumulative effects of urbanization is the destruction of wildlife habitat and farmland. The loss of land cover and ecosystem dynamics through the conversion of land to urban uses affect biotic diversity, habitat and plant and animal species survival and behavioural adaptation. Since 1966, Environment Canada's Canada Land Use Monitoring Program (CLUMP) monitored 70 Canadian cities with populations of 25,000 or more. The program surveyed the type and amount of lands converted to urban use, including tillage crops, improved grasslands, unimproved grasslands, wooded lands, mature brush and denuded land. Within the urban region, tree cover and water area were monitored and could be used to track land use change as a result of incremental development activity (Gertler and Tyler 1989). Unfortunately, CLUMP was discontinued in 1986. National land cover data will now be provided through remote sensing or satellite imagery. Statistics Canada will analyze this information for the 20 largest urban regions (Environment Canada 1992). Although the National Wetlands Working Group has gathered provincial data together to provide a detailed map of wetlands in Canada, there is no ongoing national program monitoring wetland loss due to urbanization. However, this information is routinely collected in some provinces (Statistics Canada 1991).

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4 One of the few attempts to apply an ecosystem health model to an urban context was carried out by Gariépy et al. (1990), who applied the concept to evaluate Montreal's Central District Master Plan. Unfortunately, this research did not attempt to conceptualize the urban ecosystem or justify the indicators chosen for analysis.

5 State of the environment reporting, which has been undertaken by several Canadian municipalities (especially in Ontario) is a comprehensive description of the urban environment (not the urban ecosystem). Ecological indicators are not usually included in such reporting.

Water quality

Water quality in urban areas is affected by urbanization and changes in urban form in two ways: a change in the amount of hard surfaces can increase stormwater runoff pollution, and municipal sewage discharges to water bodies may increase in pace with urbanization. Drinking water and recreational water quality are monitored in most larger urban areas by provincial and municipal authorities. Among the key parameters here are coliforms, nitrates and nitrites, heavy metals and trihalomethanes (Environmental Canada 1992). Environment Canada monitors municipal discharges to fresh water and coastal waters for biochemical oxygen demand, total suspended particles, and phosphorous (Environment Canada 199 1 b).

Air quality

Air quality is affected by the increases in motor vehicle traffic and fossil fuel combustion for building heating, two variables that are affected by urban form. Air quality has been systematically monitored in urban areas of Canada since 1970 by the federal-provincial National Air Pollution Surveillance (NAPS) network. Sulphur dioxide, nitrogen dioxide, ozone, carbon monoxide, lead, total suspended particles, and other human activity related compounds are monitored. The 428 monitoring stations located in 55 cities are classified according to the dominant land use in the vicinity: commercial, industrial or residential. This network provides a comprehensive indicator of pollution trends in urban areas over time. The land use classification may be used to distinguish the air quality effects of various development types (Environment Canada 1991b).

Throughput of the urban ecosystem

Another way in which the urban ecosystem differs from a natural ecosystem can be captured by the notion of "throughput," or energy and material (food, oxygen, water, and waste) flows. In natural ecosystems, such flows are a sign of the robustness and productivity of the system. In urban areas, however, high energy and material flows are an indication of an inefficient urban system and the degree to which ecosystems are being stressed (both the local and "foreign" ecosystems on which the city depends for its survival). According to Morris (1990: 21), low energy prices and cheap waste disposal are the two basic assumptions upon which we have built our urban systems. "We could, as a result, ignore the operating efficiencies and the byproducts of the systems we developed."

As energy costs have mounted and as citizens become reluctant to accept wastes of other regions in their 'backyards', metropolitan areas have begun to face the real costs of their metabolism (Olson 1991). This has focused attention on the issue of self-reliance as a condition of urban sustainability: a sustainable city will strive to reduce (or minimize increases of) energy and materials flowing through the system as it develops.

The form the city takes can affect several metabolic processes including the efficiency of energy use, waste production and the quantity of water flow.

Energy flow

Techniques exist for the collection of data on energy use for the preparation of a "land use, urban activity-based audit of energy supplies and demands in the community" (Roberts 1977: 37). Such community energy profiles outline the kinds and amounts of energy being used in the urban system and the purposes to which the energy is put. Energy flows of obvious relevance to the evaluation of urban form would include:

- aggregate home heating and cooling energy use
- fossil fuel consumption from automobile use
- fossil fuel and electricity consumption from public transit

These profiles can be used to analyze the pattern of energy use and may provide a baseline for growth management efforts. The Province of Ontario has produced two guidebooks for conducting a community energy profile (Lang and Armour 1982, 1983). Unfortunately, the profiles that have been conducted to date have been somewhat incomplete. Information is collected from a variety of sources and is difficult to standardize (Perkins 1991).

Urban energy consumption is monitored by individual utilities and information is usually available as energy bill totals. Unfortunately, this information is reported to Statistics Canada

only on an annual basis and is disaggregated only to the provincial level. A private firm (Synergetics) is currently conducting a household energy use survey and the results will be reported for the 25 largest urban areas in Canada.

In terms of energy use in urban transportation, Statistics Canada reports on transit energy consumption. Unfortunately, this data is only available at the provincial level. Very little information is available in terms of fuel consumption by private vehicles in cities.

Until better sources of direct information on urban energy flows are available, indirect indicators will have to suffice. These include urban transit use, which is monitored by the Canadian Urban Transit Association, the number of expressway lane-miles per capita, modal split, and the number of kilometres of bicycle paths in the region (Environment Canada 1992).

Waste flows

Waste flow is a measure of the material through-put of the urban system. It is associated with urban form in several ways: the consumption patterns of single-detached homes vary from other types of higher density dwellings, the construction and demolition of the built environment accounts for a significant percentage of landfilled waste, and housing density affects the availability of recycling services. There are no national-level data on the generation and disposal of wastes in urban regions. However, Statistics Canada is currently conducting surveys of municipalities and waste management firms in 1000 Canadian municipalities to better determine the quantity, composition and disposal methods of wastes. This information will allow researchers to determine the waste flows that result from new housing construction and infrastructure development. These surveys will also provide information on the recycling activities of municipalities and industries (Statistics Canada 1991). This information on recycling can be combined with other data (e.g. densities and participation rates, demographic characteristics) to estimate the reductions that can be expected through residential and commercial recycling programs in a new development of given characteristics.

Water flow

The urban system creates its own water flow that is connected at certain points to the surrounding hydrological system. The flow of water through the urban system will obviously grow as newly serviced areas come on line. We may expect the per capita water consumption to increase as densities fall, due to such practices as the watering of large lot lawns, a significant water drain in the summer months. Water flow is monitored at several points; domestic, industrial and commercial water use per day and volume of treated sewage flow. The information is recorded in Environment Canada's municipal data base. The source of municipal water (whether ground or surface) is also recorded.

Identifying trends

Identifying historical changes in urban form may help isolate important trends in development patterns. Such trends are important because they may present special problems or opportunities in managing regional growth, and may suggest how the urban form would change in the absence of a growth management plan. Much useful information can be garnered simply by monitoring the variables discussed above as they change over time. For instance, differentials in the rate of change in average commuting distances between inner areas and the outer suburbs can provide insight into how suburban development is affecting the distribution of employment opportunities and may suggest emerging urban forms. Secular changes in the density gradient can be used to demonstrate population decentralization over time. Other measures of development trends include the age of housing as a function of distance from the city centre. This is a simple measure that can give graphic representation of the development history of the urban area and where development pressures are likely to emerge (Boume 1989). Finally, the rate of conversion of rural land to urban land can be used as an indicator of changes in development activity on the urban-rural fringe (Environment Canada 1991b).

Demographic trends are also of great importance in identifying development pressures and the likely path of urbanization in the absence of a regional growth management regime. Information

on population growth or decline, the rate of household formation and changes in average household size will help set the planning stage.

One of the major rationales for state of the environment reporting is that it provides a baseline with which to gauge trends in ecosystem health. By monitoring pollution loadings and indicator changes over time, ecosystem stress points can be pin-pointed and related to specific urban activities such as new development and extensions of the urban envelope. By comparing energy and material flows over the monitoring period, increases or decreases in the efficiency of the urban system can be related to the form development has taken during that period.

Development potential and limitations

The ecosystem approach allows us to conceive of the environmental "services" provided by the city's surrounds, including waste assimilation, purification of water and air and the supply of raw materials and energy to the city system. Conceptualized in this way, it is clear that the urban system has ecological limits to its expansion and to the use of local resources, i.e., the carrying capacity of the region can not be breached without serious consequences to the health of the ecosystem's inhabitants.

Rees (1988a: 30) has defined carrying capacity as "the maximum rate of resource consumption and waste discharge that can be sustained indefinitely in a defined planning region without progressively impairing bio-productivity and ecological integrity." In urban areas, carrying capacity is enhanced through infrastructure extensions that disperse the bio-physical impacts of urban activities over a larger geographic area. Here, we explore both infrastructure and biophysical constraints to growth.

Infrastructure

The environmental problems of growing cities were addressed through the construction of urban infrastructure that allowed the city to draw on the carrying capacity of its hinterland. Fresh water could be drawn from ground sources or inland water bodies, waste water could be gathered and discharged into water bodies, and solid waste could be exported to hinterland landfill sites. Transportation infrastructure (roads and transit) allowed population to deconcentrate from the city core and to exploit the carrying capacity of the wider area.

> *[The urban system] is not self-supporting, instead it relies heavily on external support through connectors linking urban demand with supply sources in distant hinterlands. These connectors are the feeders and supply lines responsible for the steady state of urban functioning. Without this external input system the urban ecosystem cannot exist (Danielse 1992: 2).*

Infrastructure extends the development potential of the region by increasing the area whose carrying capacity is being exploited by a given population. Obviously, a complete inventory of existing infrastructure will be necessary before a growth management plan for the region can be developed. Here we review some of the limitations on development potential imposed by the state of infrastructure in the bioregion.

Municipal sewage treatment

The carrying capacity of the urban region will be partially determined by the proportion of dwellings being served by the municipal sewer system and treatment facilities, and by the quality of those facilities. In many areas of Canada, only primary treatment is available and urban growth has overloaded these systems, rendering them unable to produce an effluent quality that protects the receiving waters (D'Amour 1993). Environment Canada collects the relevant information on a municipal basis, including the population served by primary, secondary, tertiary treatment systems or lagoons, and the average daily flow of treated sewage. Environment Canada also monitors the population with no sewage treatment facilities, such as may result from rural estate development or development on the urban fringe.

Storm water collection

Storm water collection is made necessary due to the hard surfaces that make up the urbanized area. Extending the urbanized area or reducing open space through infill will burden existing

stormwater infrastructure and may lead to an overflow of stormwater into sanitary sewers and direct discharge **into** water bodies. The proportion of the sewer system that is combined rather than **separated** will therefore affect the carrying capacity of the urban region. Most municipalities would have this information readily available.

Average age of infrastructure

The carrying capacity of the planning bioregion is also affected by the structural integrity of existing infrastructure such as roads, water mains and sewer pipes. Much of the municipal infrastructure in Canada was created in the period following the Second World War and now requires repair or replacement. Unfortunately, public investment in maintenance, repair and replacement of infrastructure is declining, with significant environmental effects (FCM 1985). The remaining life expectancy of the existing infrastructure can help determine the available carrying capacity bioregion-wide and in particular locations.

Available infrastructure and serviced land

The availability of unused or under-used infrastructure will help determine the amount and spatial distribution of growth that can be accommodated before new capital investment is required. The availability and location of serviced unbuilt land indicates under-used infrastructural capacity and suggests where growth can occur with the least environmental impact. Such land may be newly serviced land on the urban fringe or abandoned properties in the urban core. Many cities in Canada have begun taking stock of vacant land in the already built-up area in order to encourage the infill process (e.g., Kitchener 1991; Halifax 1992; Regina 1990). The availability of serviced land on the urban perimeter is monitored by municipal and regional authorities in order to ensure a steady supply of land for housing development.

Biophysical constraints

The carrying capacity concept can be extended beyond a consideration of infrastructure limitations to include the biophysical capacity of the bioregion to accommodate development (Schneider et al., 1978). For this purpose, a spatial set of ecological zones may be used to differentiate between areas having development potential and those having development constraints.

In the 1960s, Ian McHarg developed a design process for the regional landscape in order to help ensure that urban development would occur within regional biophysical limits. The overlay method, outlined in his book *Design With Nature* (1971), is one in which social and natural systems are identified, mapped, and objectively evaluated for their development suitability. The technique involves the mapping of variables such as soil, topography, vegetation, hydrology, flood plains, and assigning each area a low, medium, or high suitability index for specific forms of development, whether housing, highways, or agriculture.

In the last decade, sophisticated technical means have become available with which to perform such ecological zoning. Geographic information systems (GIS) offer the opportunity to integrate soil, land use/land capability, water resource and socio-economic data (Radford 1993). For instance, the Sierra Biodiversity Institute in the US has developed a GIS as an aid to environmental planning. Using satellite imagery, field surveys and census information, such systems are capable of mapping watershed boundaries, locating undeveloped parcels of land, representing population densities, soil types, vegetation, topography, water bodies, the distribution of farmland and habitat fragmentation. In an urban context, Hathout et al. (1992) have used a GIS to develop environmental zones suitable for urban development in **Winnipeg.** The technique involves digital overlays of six indices (reflecting ground cover, open **space,** pollution, tree density, built-up areas, and biomass) with a resulting map showing areas that are very suitable, suitable, moderately suitable, or unsuitable for development.

Whatever the technique used, the result of this type of planning exercise is a series of biophysical constraint areas (Sosadeeter 1993). A typical classification system may include:6

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6 **For a detailed application of this technique, see the Laurel Creek Watershed Study produced by the Grand River Conservation Authority, 1993.**

- lands that serve essential ecosystem functions and that are in a relatively undisturbed state
- lands that currently have degraded ecosystem functions that could be enhanced by the development process
- **lands that** do not serve an essential ecological function but do or could serve essential human needs (transportation, recreation, housing, education, etc.).

Setting bioregional objectives

Once the urban bioregion has been surveyed and characterized in terms of urban form and ecosystem health, and after the development potential and limitations of the planning bioregion have been appreciated, regional growth management objectives can be set.

Regional growth management objectives are management tools that facilitate the implementation of an ecosystem approach to planning. They define the desired state of the urban ecosystem through a combination of scientific understanding of ecosystem processes and public consultation or partnership in decision-making.

Environment Canada has drafted a stepwise process for the development of ecosystem health objectives. The process calls for multi-stakeholder involvement to supplement scientific information. This process connects the needs of ecosystem users with the ecological needs of maintaining ecosystem function in order to produce objectives which are achievable, compatible, and sustainable.

Stakeholders are those that are directly affected by decisions related to ecosystem management or whose cooperation is necessary for the implementation of an ecosystem management plan. In the case at hand, stakeholders would obviously include the development and building industry, environmental and conservation groups, residents' associations, and local, regional and provincial government agencies.[7] As the draft Environment Canada framework puts it:

> ***The stakeholder process recognizes that humans are an integral part of ecosystems, and have a significant impact on ecosystem health. Consequently, setting reference points for ecosystem health can be seen as an effort to achieve sustainable development: it meshes the needs of humans with the best ecosystem science available to come up with objectives for a healthy ecosystem in which humans live within the ecosystem's carrying capacity (Environment Canada, 1993: 10).***

Growth management objectives may be divided into two groups: ecosystem objectives and development objectives.

Ecosystem objectives reflect the desire of the community to maintain or improve ecosystem parameters that are affected by urban growth and the choice of urban form. Ecosystem objectives may include:

- regional air quality targets (e.g., to reduce the pollution index to acceptable levels year round; to maintain air quality regardless of future development)
- groundwater and surface water quality targets (e.g., to improve ground water quality to drinking level standards; to improve surface water quality in degraded areas of the region such that fish habitat is restored)
- water quantity targets (e.g., to reduce the impact of urbanization on water levels in surface water bodies)
- degree of habitat preservation and restoration (e.g., to establish a regional network of linked nodes and corridors; to re-establish original wetlands in 10% of the bioregion; to re-establish habitat of locally extinct indigenous species)

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[7] **A strategic planning process has been carried in several Canadian jurisdictions involving numerous stakeholder groups. For example, Rurlington** (1991), **Kelowna** (1992), **Kingston Township** (1991), **Calgary (1989) and Vancouver (1992). For an example of an elaborate community visioning project in the US, see the Citizen Planners Project of Ventura County (1991). Although they involve the visioning of desirable forms of development and environmental attributes, they rarely progress beyond the "principle" stage to the formulation of concrete community development and ecosystem objectives.**

- waste generation targets (e.g., to reduce the amount of waste produced by residential development by **20%** and to increase participation in recycling programs to 100%)
- **energy use** targets (e.g., to reduce energy-intensive forms of transportation by 10% per year; to reduce average space heating energy requirements by 5% per year).

Development objectives reflect the desired quantity and quality of growth in the urban bioregion. In traditional planning approaches ("trend planning") growth is assumed to be exogenously determined and the planning challenge is to meet this growth with the least disruption to the social and fiscal integrity of the region. In contrast, a carrying capacity approach assumes that growth targets should be set by the community according to its ability to invest in new infrastructure and in recognition of the biophysical limits of the region. Thus, carrying capacity planning has traditionally been concerned with reducing the intensity of human use of the land and has allied itself with those advocating growth controls designed to minimize or eliminate population growth (Finkler and Peterson 1974).

The debate over the environmental implications of the compact city has shown that the situation is somewhat more complicated than this. Indeed, population concentration may be the most effective means of reducing the per capita environmental impacts of the human use of land. The benefits of concentration would be expressed in the increased efficiency of the urban metabolism and the reduction in per capita energy and materials use and waste generation. Development may also be perceived as a force of change in the bioregion that can help restore ecological functions that had been degraded by unsustainable development practices:

> *The real challenge in applying the ecosystem approach is to establish management targets based, not on the current state* of *the ecosystem, but on the potential for what the ecosystem could be. The objective of ecosystem management is enhancement, not status quo or minimizing impacts (MTRCA 1990: 8).*

Inevitably, the setting of development objectives will involve a political process that balances these ecological considerations with each other and with non-ecological variables such as the need for affordable housing, to stimulate the construction industry, or attract outside investment. The ecosystem objectives will provide a framework for decisions about the amount of environmental stress that will be tolerated in the bioregion and the degree of remediation or restoration required.

Formulating and assessing alternative urban forms

Once the development and ecosystem objectives have been established, the potential urban forms that will meet these objectives can be formulated and assessed. This may be done in either of two ways: a sequential-iterative process of plan formulation, assessment and reformulation based on the assessment outcome, or by means of formulating several development scenarios and simultaneously submitting them to an impact assessment to determine the preferred form. Here, we explore the second possibility.

The ecosystem and development objectives formulated in the previous planning step will very likely be compatible with several development scenarios. Such scenarios would normally address the following issues:

- the degree of extension of the urban envelope, i.e., the degree to which growth will be accommodated within already built up areas
- the type of constraint area that may be considered for urbanization, i.e., essential ecological functions, degraded ecological functions, essential human functions
- the bioregional structure, i.e., the number and hierarchy of urban centres
- region-wide infrastructure needs, i.e., new arterial roads, trunk sewers, chanellization of streams or rivers, and so on.

The results of this stage should amount to a selection of "pictures" or maps of the bioregional landscape summarizing the key features of each development scenario: areas to be developed, areas to be preserved, the structure of settlement and employment nodes, regional transportation and other principal infrastructure supporting the desired urban form. One of the scenarios should

represent the situation that would arise if current development and ecosystem trends continued. Each scenario should include:

- a statement of how the scenario is intended to affect ecosystem objectives including the increase (or decrease) in throughput of energy, water, and waste compared to the current trends scenario
- an estimate of how the scenario will help achieve regional development objectives
- an estimate of the infrastructure costs associated with the scenario.

Once the scenarios are formulated they will need to be formally evaluated to determine which best meets the established development and ecosystem objectives. In principle, cumulative effects assessment (CEA) is ideally suited to evaluating the environmental impacts of the large number of development activities contemplated by any growth management scenario. The Federal Environmental Assessment Review Office has defined cumulative environmental effects as "the interaction, combination and compounding of environmental effects associated with one or more activities. These effects may occur over time and space, gradually altering the structure and functioning of biophysical systems..." (FEAR0 1993: 1).

Unfortunately, a rigorous scientific assessment of the cumulative effects of the various urban form scenarios would be impracticable for several reasons (Wood 1988):

- the plan is concerned with many types of development in many different locations, rendering the scientific assessment of the cumulative impacts of the plan immensely complicated
- the nature, scale, and precise location of the development permitted by each scenario are not described and therefore the impacts of each scenario can not be precisely predicted
- techniques for applying environmental assessment methods to the strategic planning level are underdeveloped

The uncertainty involved in assessing scenarios is likely to be aggravated by the intensely political nature of growth management decisions. For example, Susskind et al. (1978) analyzed the environmental assessment process and found that the interest of developers and environmentalists were diametrically opposed, threatening to debilitate the process. Environmentalists were mainly concerned about long-term and cumulative impacts of development decisions, were adverse to taking environmental risks and tended to view the environment holistically. In contrast, developers tended to separate development from its impacts, liked taking risks, adopted a narrow view of the environment, and emphasized the short-term benefits from investment.

What is the best way to evaluate the growth management alternatives under such conditions of uncertainty and conflict? Many sophisticated methods have been suggested including Delphi forecasting consultation, negotiation and bargaining, cost-benefit analysis, goals achievement matrix analyses, and strategic choice approaches (de Jongh 1988). Of these, the most promising might be cumulative impact analysis. Cumulative impact analysis is distinguished from cumulative effects assessment in that effects assessment refers to a scientifically determinate activity while impact analysis is defined as "a comprehensive planning view that incorporates values, public perceptions and trade-offs" (Stakhiv 1988; quoted in Hubbard 1990: 13). Impact analysis is therefore "part of a broad framework in which development and growth can be evaluated against the impacts that are likely to occur given past trends, present conditions and future expectations" (Hubbard 1990: 13).

Whatever the method chosen it will need to address the following process and substantive issues: [8]

Process Issues:

- It should be inclusive and interactive, promoting cross-disciplinary collaboration amongst experts, and the widest participation of interest and citizen groups and the public at large.
- It should be directed towards achieving the highest possible level of consensus given that the cooperation of most stakeholders will be necessary in order to implement the plan.

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[8] Adapted from Gardner, 1988.

- It should provide a means of making value-based choices among objectives in cases where they compete with each other (e.g., carrying capacity versus throughput) or with non-ecological objectives.
- It should provide a mechanism for integrating value choices with scientific information about environmental impacts of development scenarios.
- It should be adaptive, making provisions for the correction of the development scenarios if initial assumptions turned out to be wrong.
- It should provide for on-going research into and monitoring of the environmental effects of regionally significant development decisions.

Substantive Issues:

- It should be oriented towards system-level effects of the development scenarios. Thus the cumulative effects of each development scenario should be estimated on each of the ecosystem objectives and across objectives. In particular the effects of a large number of small development projects anticipated by the development plan would be assessed for their effects on water quality, air quality, biological diversity, green space and so on.
- It should give detailed attention to the current urban structure and ensure that the proposed changes to the urban form are achievable without giving rise to environmental consequences not contemplated in the scenario.
- It should consider whether mitigative measures will be necessary to address environmental issues arising as a result of the proposed scenario.

The final choice of scenario to be adopted in the region may be made directly as a result of this public process or through the decision of political representatives. Presumably, the greater the degree of public involvement and consensus building, the greater influence that process will have in choosing the desired development scenario.

Implementing the regional plan at the sub-regional and site level

To achieve the preferred urban form, urban growth needs to be managed on three levels, the regional, sub-regional, and site levels.9 The regional planning system outlined above has two drawbacks:

- it overlooks the importance of the sub-regional level as a planning unit towards which citizens may identify more closely than with the bioregion, and which may serve as an intermediate planning area for the adaptation and modification of regional plans.
- the specific projects that will be regulated by the plan are not known at the time of plan-making and therefore the detailed cumulative effects of the plan can not be predicted.

Thus, the regional planning framework should include provisions for its application at the sub-regional and site levels. For this purpose, the model of nested watershed and site management planning may be adapted to the urban bioregion (MNR 1991; MOEE and MNR 1993a, 1993b, 1993c).

Sub-regional planning

Many of the elements of the regional planning framework outlined above may be useful at the sub-regional level.

Boundaries: Growth management efforts may be organized using watershed boundaries to define the planning unit. The watershed more often relates to historical settlement patterns than the bioregion and therefore may reflect residual place identities (Alexander, 1991). It is therefore an ideal unit for the intense involvement of local residents and stakeholders in the planning process.

Surveying the watershed: Watershed inventories may be carried out at a finer grain than at the regional level, detailing the existing settlement patterns and features including housing mix (single-family, multi-family and apartment), employment centres and sub-centres, transportation patterns (walk, cycle, motor to work, non-work related trips) and so on. The inventory may also assess more detailed ecosystem health characteristics such as stream bank erosion, flooding

9 Of course, these three levels of analysis and planning are inter-related: for example, a large number of development projects at the site level will change the regional form, while a regional plan for managing urban growth will affect how planning agencies evaluate specific development projects.

potential, site hydrogeology and soil characteristics, the presence of woodlots or tree densities, and so on.

Development potential and limitations: The carrying capacity of the watershed area can be assessed by a finer grained evaluation of existing infrastructure and buildings. Specific sites for infill development, redevelopment of non-residential sites, or adaptive re-use of existing buildings may be identified. Already serviced sites that could accommodate new growth or biophysically suitable sites for greenfield development could be identified. Environmentally sensitive sites to be preserved or restored may be determined by a detailed assessment of the biophysical features of the watershed.

Setting Watershed Objectives: Using regional level objectives as a framework, more detailed development and ecosystem objectives may be set at the watershed level. Development objectives may include:

- proportion of regional population change that will be accommodated in the watershed
- housing types (single-family, multi-family, apartments)
- land use mix (local employment and residential)
- number and hierarchy of sub-centres

Ecosystem objectives may include:

- translation of regional objectives into watershed objectives reflecting the effort watershed communities will be willing to make in order to help reach bioregional objectives
- more detailed objectives relating to water quality, and habitat preservation and restoration.

Watershed plans: Watershed scenarios may be developed and evaluated as alternative ways of achieving watershed objectives within the constraints of regional plans. Conflicts with the regional framework or contradictions within it are bound to emerge as it is applied at the sub-regional level. Such eventualities should not be shunned as they may provide an opportunity for local individuals and groups to contribute their intimate knowledge of the watershed and its biophysical processes and to adapt the regional framework to local human needs. Implementing the regional plan at the watershed level may turn up evidence that the assumptions made at the regional level were incorrect or incomplete.

Regional implications of watershed plans: In order to deal creatively with these possibilities, the regional framework should be flexible enough to permit some variation on the sub-regional level or in cases where real contradictions between regional and sub-regional objectives are discovered, to consider adapting the regional planning framework. The regional framework should therefore set out the extent to which subregional plans are bound by the overall plan and the extent to which issues addressed at the overall plan stage can be re-opened in deliberations on the watershed level.

Application to specific sites and projects

Because the chosen regional development scenario does not specify particular development projects, some process is needed to ensure that regional objectives will be respected by the myriad of development projects that the growth management plan allows. Once again, the analysis of cumulative impacts is crucial to evaluating development projects in a regional perspective. Rees (1988b: 286) for instance, has observed that:

> *Land use and development patterns would be controlled under sustainable use planning criteria.... Within the sustainable development framework, cumulative effects assessment would provide the means to estimate how close we are to developmental limits specified and imposed by the carrying capacity considerations of the regional plan.*

One way of ensuring consistency with regional objectives is through impact statements. Under this regime, major development projects would include an impact statement prepared by the proponent and reviewed by the watershed planning authority. The statement would demonstrate:

- how the proposal fits with the spatial land use and infrastructural requirements of regional and sub-regional growth management plans

- what contribution the project would make to achieving ecosystem objectives expressed in the regional and sub-regional plans
- what contribution the project would make to achieving the development objectives expressed in regional and sub-regional plans

If projects are found to be inconsistent with regional or sub-regional plans on any of these points, the project could be submitted to a formal environmental assessment focusing on cumulative effects. This assessment would examine potential alternatives to the proposed development (i.e., other projects that would achieve the stated development and ecosystem objectives) and alternatives for the development (different ways of carrying out the proposed project).

Regional implications of sites and project planning: The regional plan should contain guidelines setting out the types of development projects foreseen by the plan and the planning processes each will be subjected to. For this purpose, the best available model is provided by the class assessment process. It would: 10

- define the set of undertakings involved
- distinguish between major and minor undertakings and define the planning process for each
- provide for exceptions to the standard planning requirements
- include requirements for monitoring implementation and actual results of the plan.

Monitoring the implementation of the growth management plan

Monitoring has been the Achilles' heel of both the environmental assessment and the land use planning system. Rare is the case that the terms and conditions associated with an environmental assessment approval are followed up with a rigorous monitoring program. Nor are development agreements reached under the planning approval system routinely monitored for compliance.

The planning framework proposed here relies heavily on the existence of ecosystem monitoring programs, such as those that were identified in setting the stage for the growth management exercise. Monitoring should continue on the local scale in order to ensure compliance with watershed and regional objectives and with the conditions attached to project and site development proposals.

10 Adapted from Gibson (1993).

5 Jurisdictional issues in implementing the planning framework

In the previous section, we developed an ecosystem planning framework for growth management in an urban bioregion. This model was intentionally developed as an ideal type; the focus was on detailing a planning model that was internally consistent and consistent with the emerging theory and practice of ecosystem planning and sustainable urban development. Although sources of information were noted where appropriate, no attempt was made to "fit" the model within existing institutional arrangements. In this section, we briefly explore growth management in the Toronto region in order to gain insight into how the proposed planning framework can be integrated into existing planning and institutional arrangements or how those arrangements need to be modified to accommodate the planning framework. 11

Background

Since the Second World War, the Toronto area has been the fastest growing region in Canada. During this time, the population has increased from about one million to almost four million people. Population projections forecast that an additional two million people will live in the Toronto region within a generation.

As a response to the pressures of growth, in 1958 the Province of Ontario established the first metropolitan government in Canada, the Municipality of Metropolitan Toronto. At the time of its incorporation, Metro encompassed the greater part of the urbanized region and included a planning area beyond its formal boundaries in order to capture those areas subjected to development pressures. In the years after its incorporation, Metro was able to accomplish a great deal in terms of regional growth management: metropolitan road and public transit infrastructurwere put in place, population densities were maintained around transportation nodes and corridors, and a "city that works" was created.

By the 1980s, however, the planning area surrounding Metro had been incorporated as separate regional governments and the urbanized area had spilled over the 1958 boundaries such that regional planning issues could no longer be dealt with in the existing framework. Low density development on the periphery of the urban area had become the norm, several sub-centres had developed to the east, north and west of Metro Toronto, infrastructure planning had become fragmented and sometimes contradictory, and environmental and quality of life issues (such as the availability of affordable housing, traffic congestion, air and water pollution, and loss of habitat) had become pronounced.

Current jurisdictional arrangements

The jurisdictional arrangement governing growth in the Toronto region is extremely complicated. Several levels of government and several agencies within each level may be involved in land use decision-making, either through monitoring, regulation or by virtue of their commenting function on official plans.

Conservation Authorities

Conservation authorities are established under provincial statute and are organized on a watershed basis. Their directors are principally drawn from local and regional municipalities, and provincial agencies. conservation authorities in principle have very wide conservation and watershed management powers but have traditionally restricted themselves to fill regulations, flood control and the management of conservation areas. There are six conservation authorities in the GTA, each of which has developed watershed plans and conducted related studies detailing ecosystem characteristics. Conservation authorities are also involved in ongoing ecosystem monitoring in the Toronto area. For instance, the Metro Toronto and Region Conservation Authority monitors the effects of lake filling on water quality, sediment and biota. More recently, conservation authorities have begun to shift towards a more pro-active ecosystem planning role (CAO 1993).

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11 Davies (1991) has provided an overview of the potential for ecosystem planning in the Toronto bioregion, but paid little attention to jurisdictional issues which are of principle interest here.

Municipal and Regional levels

The four regional and one metropolitan governments comprise 35 area municipalities in the GTA. Regional and metropolitan governments are responsible for determining the pattern of settlement but tend to restrict themselves to the policy level and generally do not engage in land use zoning. In principle, regional governments are responsible for region-wide infrastructure such as arterial roads and trunk sewers. Municipal level governments maintain most of the land use planning powers to control development but are subject, through plan approval requirements, to regional and provincial land use and sectoral policies.

Federal and Provincial levels

The federal government has jurisdiction over some regionally significant infrastructure decisions such as airports, harbours and certain aspects of ecosystem health such as water quality (although this is largely delegated to the province in the case of Ontario), and the building code. Federal government agencies such as Statistics Canada, CMHC, and Environment Canada play a major monitoring and information gathering role in the Toronto area.

Several provincial ministries are involved in monitoring and regulating aspects of ecosystem health. The Ontario Ministry of Environment and Energy monitors air quality and drinking water quality in the Toronto region as well as waste flows. Local health units of the Ministry of Health monitor recreational water quality. The Ministry of Natural Resources monitors wildlife and greenspace in the area.

The Ontario provincial government is the most directly involved in managing regional growth. It has the power to create regional governments in response to growth pressures, to restrict development through provincial planning policies, or to shape development through affordable housing policies. It is the major funder of significant infrastructure development in the province and has control over development standards that affect the amount and density of development. In the late 1960s and early 1970s, the provincial government undertook an abortive growth management initiative for the Toronto region (Plan Canada 1984). In the late 1980s, another attempt to deal with issues of regional growth was initiated and is currently unfolding. We turn now to a brief overview of this initiative.

Current growth management initiatives

In 1987, the Ontario government created the Greater Toronto Coordinating Committee (GTCC), composed of the chief administrative officers of Metro Toronto and each of the four surrounding regional municipalities (Durham, York, Peel and Halton) to consider the major infrastructure needs in the Greater Toronto Area (GTA). The Office of the Greater Toronto Area (OGTA), in turn, was created in 1988 to provide staff to the GTCC. The growth management initiative began with a population study that was conducted in close association with the regional municipalities and forecasted that approximately another 2 million people would be living in the GTA by 2021. In 1990, the GTCC and the OGTA contracted a private firm (IBI) to explore the various implications of such a population increase. Three urban form scenarios were proposed - spread, nodal, and concentrated urban form - and assessed from a variety of perspectives, including environmental. Environmental assessment included implications of the three urban forms on land and water resources as well as transportation emissions and energy consumption. The study concluded that concentrated development was the most desirable from an environmental point of view (with some qualifications) but required unrealistic levels of government intervention to achieve. The IBI report was circulated for discussion among the municipalities in the GTA and responses were solicited.

Parallel to this study, the provincial government launched two related initiatives: It commissioned a study on greenlands in the GTA and asked the federal Royal Commission on the Future of the Toronto Waterfront (directed by David Crombie) to expand its mandate to include matters of provincial interest. Following these planning exercises, the OGTA published a report advocating an ecosystems approach to growth management: *Growing Together: Towards an Urban Consensus in the GTA* (1991). The report summarized the results of consultations with municipalities on the IBI study and highlighted points of agreement with the interim report of the Crombie Commission (1990), *Watershed,* and the *GTA Greenlands Strategy (1990).* The

OGTA's second report, *GTA 2021: The Challenge of Our Future* (1992) reported "an emerging consensus" about a sustainable built environment and proposed a regional vision for the year 2021.

The emerging consensus pointed towards a nodal urban form with an increase of transit investment and land use planning to reduce commuting needs by providing a better balance between housing and employment. As a result, the OGTA set about developing a strategic framework for growth management in the GTA. Toward this end, six working groups were established to study various aspects of this framework, including urban form, countryside, and infrastructure. The working groups were staffed almost exclusively by provincial and municipal representatives. Recommendations from these groups were published in 1992 along with a "working document" outlining the growth management vision to be achieved by 2021. This document, entitled *Shaping Growth in the GTA*, (Berridge Lewinberg Greenberg Ltd., 1992) in turn served as a basis for public consultations, largely involving the regional and municipal councils. The end result of this process will be a growth management policy statement under the Ontario Planning Act. [12]

Interestingly, however, the "consensus" around a nodal development pattern actually concealed substantial conflict over the meaning of the phrase. On the one hand, Metro Toronto embraced a "concentrated nodal" development that would prevent the extension of the urban envelope and concentrate much of the expected population increase within the borders of Metro. On the other hand, York endorsed a "modified nodal" urban form, Durham favoured a "macro nodal" growth scenario, and Peel recommended an "exaggerated nodal" form of development, all of which would allow greater population growth in the outlying regions and at lower densities than the IBI concept suggested.

Nor could major stakeholders be said to have enthusiastically embraced the nodal consensus proposed by the OGTA: the development industry is seriously concerned about the implications for the supply of developable land (Chris Burke, personal communication), while many environmentalists reject the massive growth projections that lay behind the whole planning exercise (Toronto Environmental Alliance 1993).

Jurisdictional issues and recommendations

This description of the GTA growth management initiative highlights several jurisdictional and institutional issues with respect to using the proposed ecosystem growth management planning framework. Here we discuss several of those issues and make recommendations for applying the proposed framework.

Boundaries of the planning: area

The boundaries of the GTA are based on political units: namely the outer perimeters of the four regional municipalities around Metro Toronto. According to a Metro Toronto planning document (1990: 8)"It is recognized that the use of these boundaries for planning purposes is arbitrary. The GTA is a part of a larger hierarchy of settlements within southern Ontario and has important urban linkages beyond the municipal boundaries of the GTA to Hamilton-Wentworth, Kitchener-Waterloo and other municipalities. Decisions respecting growth within the GTA have impacts upon this extended area and vice versa." Richardson (1991) has argued that it is this larger region that should be considered as the planning unit for growth management in the Toronto region, especially the continuously urbanized area along Lake Ontario and including Hamilton.

Another key problem with the GTA boundaries is that they pay scant attention to natural boundaries. The political boundaries of the regional municipalities that makes up the perimeter of the GTA do not correspond to any natural landscape features or water systems. The major landscape features of the region are the Niagara escarpment to the west and the Oak Ridges Moraine to the north and running east to the Trent-Severn waterway, forming an east-west

[12] The Ontario Planning Act is currently under review by a provincial commission, chaired by former Toronto mayor John Sewell. In a longer report, we would explore the connections between the reforms being proposed by that commission and the ecosystem planning framework being proposed here.

depression in which most of the urban area is contained. 13 The Oak Ridges Moraine is the source of most of the rivers and streams flowing across the face of the Toronto area and into Lake Ontario, and serves as a convenient bioregional boundary.

Recommendation #1:

The planning area should be redefined to reflect the major landscape features of the region and daily commuting patterns. The planning area should be conceived of as an aggregate of watersheds and the outer perimeter of the planning area should be delineated by watershed boundaries.

Bioregional planning authority

Planning authority in the GTA is highly fragmented between levels of government and among agencies within governments. The OGTA itself is not a planning authority in that it does not control land use or development in its geographical jurisdiction. Rather, it is a provincial body that uses "carrots and sticks" to encourage regional governments to co-operate in resolving trans-boundary issues. Regional governments in the GTA, on the other hand, have shown little interest in regulating land use for environmental purposes. 14 Indeed, two of the four regional municipalities still do not have official plans after 20 years in existence. This conclusion echoes that of Richardson (1989: 14) who found that "the fact that an intermunicipal plan is constrained by municipal powers and oriented towards municipal interests almost rules out the possibility of an ecosystem based approach to appropriate land use.. ." Finally, it should be noted that regional municipalities in the GTA are widely considered to be artificial creations for administrative purposes. They have garnered little allegiance from their residents, who continue to identify with municipal-level organizations.

Recommendation #2:

Regional municipalities in the GTA should be abolished or substantially diminished in their powers over land use and infrastructure development. These powers should be transferred to the bioregional planning authority. The bioregional planning authority should be the level at which a growth management strategy is formulated, involving a wide array of stakeholders. The planning authority should also be the level at which provincial policies are translated into land use terms to guide sub-regional planning. The authority may take the form of a council comprised of representatives from the watershed-level planning authorities.

Information collection

To the planning authority, the reality of the urban ecosystem is only as great as the quality of ecosystem-based information available. The OGTA has not conducted any systematic appraisal of ecosystem attributes in the GTA. On the other hand, our case study shows that many other agencies, provincial, federal and other, are actively gathering information relevant to assessing ecosystem health.

Recommendation #3:

The bioregional planning authority should serve as a central clearinghouse for information on the ecological health of the region. Attempts should be made to standardize information gathering and monitoring activities to increase its usefulness in bioregional planning.

Bioregional Objectives

The ecosystem planning framework proposed here requires that bioregion development and ecosystem objectives be set in a broadly consultative fashion. The GTA planning process set development objectives (e.g., population increase) in consultation only with regional municipalities. No ecosystem health objectives were formulated.

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13 These are the boundaries of the Toronto bioregion as defined by the Royal Commission on the Future of the Toronto Waterfront.

14 This corresponds to the situation in the US: "It is unfortunate that in the nation's existing metropolitan regions, where most growth control and growth management debates are taking place and where issues of population distribution are most clearly posed (and perhaps most potentially solvable), the institutions of regional government, which might be expected to take the lead in development of strategies and policies, are weak and can seldom take an effective leadership role" (Finkler et al. 1974: 10).

Recommendation #4:

The bioregional planning authority should be empowered to conduct an extensive objective setting exercise before proceeding with the strategic planning process. This should include both development and ecosystem health objectives.

Assessing growth management scenarios

The ecosystem approach to growth management calls for wide-scale public involvement in the formulation and evaluation of growth management scenarios. In the GTA initiative, growth management scenarios were formulated by the OGTA and evaluated by IBI, the private firm contracted for the growth options study. Our brief study of this case indicates that the announcement of an emerging consensus among local governments and non-governmental organizations may have been premature. Indeed, it may be an institutional conflict of interest to allow the agency that organizes the formulation of scenarios to also evaluate their performance. The question arises, then, as to who should be in a position to evaluate growth management scenarios if not the bioregional planning authority?

Recommendation # 5:

In order to ensure its objectivity, this assessment should be carried out by an agency independent of the planning authority formulating the growth management scenarios. This responsibility should be given to a council composed of representatives of bioregional watershed management authorities. The council should have the authority to report directly to the Minister of Municipal Affairs.

Sub-regional planning

The ecosystem planning model proposed here relies on watershed planning at the sub-regional level. The regional growth management strategy being pursued in the GTA has no formal relationship with the watershed studies and plans that have been developed by the GTA's conservation authorities. Instead, it will rely on the legislative authority of the Planning Act to require municipalities to incorporate the regional growth management strategy into their official plans and amendments.

The problem arises because municipal boundaries do not correspond to either biophysical processes nor to the economic metabolism of city regions. On the other hand, many citizens have strong allegiance to municipal institutions and municipalities perform important functions unrelated to regional growth management. Therefore, their continued existence is guaranteed.

Conservation authorities in Ontario have begun to take on more pro-active roles in the management of land use affecting watershed integrity. In the Region of Waterloo, for instance, the Grand River Conservation Authority (1993) has co-ordinated the development of a growth management plan for an urbanizing area on the city's west side. The plan is currently being incorporated into Waterloo's regional and municipal planning framework. A recent report of the Conservation Authorities of Ontario (1993) suggests that conservation authorities shake off their traditional preoccupation with erosion and flood control and undertake to play a central role in ecosystem planning on a watershed basis.

Recommendation #6:

Municipal land use decision-making should be subordinate to plans developed on a watershed basis by conservation authorities or their institutional successors. The watershed authority should be granted greater powers than the currently constituted conservation authorities, including the power to approve municipal official plans and plan amendments, to review cumulative impact statements of project proponents, and to reject development proposals that do not meet watershed and regional objectives.

6 Conclusions

By way of conclusion, we can consider several objections that may be raised against the proposed planning framework:

- *Developers will not support such a system because it requires too much public participation and could lead to further delays in procuring development approvals.*

While it is true that the proposed framework relies on a much higher degree of public participation than is currently expected, this does not mean a less efficient approvals process. Planning approval is currently inefficient partially because citizens opposed to certain developments have no choice but to bog the approval process down in regulatory procedures such as environmental assessments. A more rational and inclusive process that permits genuine participation and a commitment to consensus among stakeholders might actually improve the efficiency of the approvals process by getting all stakeholders on side. Furthermore the proposed framework sets out a simple hierarchy of development authority based on bioregional and the component watershed authorities with responsibility for information standardization, setting development and ecosystem objectives and planning and development approval. This should have the effect of reducing institutional fragmentation and giving developers fewer windows through which to interact with the regulatory process.

- *Municipalities will resist the **proposed** framework because it diminishes their powers and carves them up into watershed units.*

It cannot be denied that the proposed framework will significantly alter municipal responsibilities for land use. Responsibility for development control and conservation planning would be removed and placed with the watershed authorities. On the other hand, municipalities would continue to perform those functions to which they are particularly suited: for instance, cultural heritage preservation, indoor recreation, social service provision, property services such as garbage collection, and so on. It is widely perceived that municipalities lack the resources for effective growth management; their legitimacy and efficiency can only be increased by restricting them to functions for which they are suited.

- *The **proposed framework** will reduce the housing choice available to consumers because it interferes with the free market in housing. Therefore housing consumers are unlikely to support it.*

The "free market in housing" is actually reducing consumer choice on a regional scale. Hirsch (1976) has pointed out that when home seekers pursue the ideal location on the urban-rural fringe, they actually contribute to the extension of the urban envelope and the destruction of the sought-after condition. Unmanaged growth may also reduce the choice of transport options, housing affordability, and employment locations. Thus, the issue of choice has gradually climbed from the individual to the regional level; the only meaningful choice now available must be exercised through political institutions that govern the growth of regions.

There is also considerable evidence that the current trends in urban form are less the result of a free market and more the by-product of other policy choices: e.g., the tendency for municipalities within a region to compete for outside investment, the uncoordinated public provision of transportation and communication infrastructure, public subsidies for car use and larger homes (Hanson 1992; Nelson 1992).

Neuman (1991: 346) has taken this line of thought the furthest. He has presented evidence that sprawl says less about the urban forms people desire and more about what they are offered by the development industry and planning professionals. He makes the interesting distinction between the housing-type preference, which he admits is overwhelmingly single-family, and the preferred form of community. "While Americans may prefer single family homes, this does not mean they want them to exist in sprawling forms." He goes on to cite evidence showing that community residents, when shown images of both sprawl and traditional housing and community types, prefer traditional types anywhere from four to one to eighty to one.

- *The **proposed** framework merely replaces regional government with a new layer of planning control at the watershed level. Because they are composed ofmunicipal representatives, watershed authorities will be subject to the same fragmentation and development pressures as the former regional **governments.***

This is certainly a valid objection and suggests that the locus of reform can not be isolated in the planning system. The ecosystem approach to growth management is essentially goal-oriented. This means that planning seeks "pre-identified goals in a normative, pro-active way...." (Gardner, 1988: 5). The growth management experience in the GTA demonstrates that regional governments and municipalities are much influenced in their deliberations over urban form by the issue of assessment base. This preoccupation is understandable given the importance of the property tax in municipal revenues, but tends to undermine goal-oriented planning.

Thus, rational growth management on a regional scale favours the abolition of the property tax system and its replacement with a less distorting mechanism of raising revenue for local and regional planning authorities. This will require that alternative funding methods be researched and experimented with.

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