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ENVIRONMENTAL PLANNING RESOURCEBOOK

Reg Lang
Audrey Armour

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The cover, from a drawing by the German scholar Athanasius Kircher in 1676, depicts the centre of the Earth as a giant Inferno. Water seeping in from the Ocean became hot springs. Tongues of fire close to the surface started Volcanoes, cooled by the four Winds.

Preface

Canadians have recognized for some time that their land resources are finite and that a planned approach to land/space use is necessary to resolve land use conflicts. There is now a realization that these lands are vulnerable and that man's use or misuse of the land is central to most problems of environmental degradation. Consequently, there is a need to alter the traditional land/space use planning process in order to give it a broader environmental perspective oriented toward the protection of environmental values. This broader environmental approach to land planning is referred to as "Environmental Planning".

The Environmental Planning Resourcebook responds to a need for a comprehensive information base, deeply rooted in the Canadian experience, to assist land planners across Canada with their planning responses to environmental problems. It is also hoped that the Resourcebook will contribute to the development of the State-of-the-Art in this young and self-searching field.

Professor Lang is well known in the land planning field. He and Professor Armour have been among the first to introduce the concept of Environmental Planning in Canada. The Lands Directorate is pleased to bring their work to the public's attention through publication of the Resourcebook.

R.J. McCormack
Director General
Lands Directorate

Foreword

This book assembles a base of information that should be useful to practitioners and others engaged in or concerned with various kinds of environmental planning problems in Canada and elsewhere. It considers the nature of environmental problems and planning, describes environmental resources, examines selected environments and activities, and documents recent and current environmental planning and management initiatives. The book responds to a certain perception of the environmental planning field and of the needs of those involved in it.

It was suggested recently that an appropriate coat of arms for the planner, would be "crossed purposes on a field of aspirin". "Shrouded in smog" completes the image for the environmental planner who is working in a field with no clear focus and no distinct limits. Although its practitioners share a preoccupation with environmental issues, they lack a common language. Their field covers a wide range of subject matter, encompassing both "natural" and "human" environments, but an agreed conceptual framework to distinguish between or relate these environments is missing. Complicating things is the involvement of a variety of disciplines, each with its own paradigm – that body of beliefs, values, ideas and theories which practitioners of a discipline accept and profess, and which guides their selection and definition of problems, their explanations of phenomena, their methods of attack and generally their views of the world. Paradigms operating in the environmental planning field have various points of agreement and conflict. Because a paradigm is often difficult for its adherents to "see", however, the real sources of such conflicts are seldom articulated. Hidden agendas result, inhibiting interdisciplinary work and retarding development of the field. Further confusion is added by the proliferation of public and private interests, responsible for and affected by environmentally oriented actions, which may bring a variety of perceptions to environmental problems. Public and political pressure for corrective and preventive environmental action is equally variable. Popular environmental concern may appear to have waned since the early 1970s but a recent survey by Resources for the Future shows that it has, in fact, remained strong and steady. Demands for action are becoming increasingly vocal and environmental controversies regularly erupt in the media. However, funds for needed responses are scarce, and will be even more so as energy and resource shortages drive up costs. Severe challenges to environmental planners are highly probable.

The considerable number of Canadians who practice and study in the environmental planning field have certain common needs which an information resource such as this can usefully address. These include:

- Frameworks and concepts to pattern experience, structure the definition of problems, organize environmental planning processes, guide data searches and selection of interventions, facilitate the transfer of experience from one context to another, and help explain environmental planning to clients and other non-practitioners.
- General information and data sources on significant environments and man-environment relationships – what they comprise, how they function, what value they have for people and communities, what threatens those values, and what responses are needed.
- Workable planning approaches, methods and feasible solutions to specific environmental problems, with information about their institutional and cultural contexts to indicate the potential for transfer and adaptation to other settings, organized so that a planner can develop variations and advance them in ways appropriate to the given place. H.W. Richardson argues (in *Regional Growth Theories*, Macmillan, 1973) that the acceptance of an innovation at any level in the hierarchy depends on the willingness of decision-makers to accept new ideas, how often they hear of their successful application, their technical and economic feasibility, and the lack of technical bottlenecks. Environmental planning innovations are hampered by lack of the means, including information, to make this kind of case.
- Guides to current thought and practice in the field, including who is doing what where, as the basis for creating information exchange and generating mutual support.

These perceived needs led to the decision to use a "resourcebook" approach. It was seen as a way of getting started (no such Canadian source now exists), as a means of reducing the variety of information to a comprehensible level so that the development and application of knowledge might proceed in a more focused manner.

The Resourcebook organizes access to several kinds of information: books and reports on environmental planning approaches and methods

(with emphasis on the former), documented experience especially in the form of case studies, and other data sources including people and organizations to contact. It goes beyond a state-of-the-art review by structuring information on environments, problems and planning according to a concept of what environmental planning is and how it should proceed. Yet the Resourcebook is not an in-depth text or a cookbook of techniques. The aim is to provide less of a how-to-do-it than a where-to-find-it. The environmental planner, researcher, teacher, student or concerned layperson can expect to proceed from 1. a specific planning problem to 2. this book for identification of one or more information sources, and so to 3. the source(s) directly (titles, publishers, addresses, costs, phone numbers, etc.) to further investigate a possible solution and its applicability to the particular setting, and finally 4. back to the problem. Seldom will a reader be able to go from 1 to 2 directly to 4. The Resourcebook, because of its breadth, assists the reader in pursuing the depth of research his/her problem demands. Because the field is diverse and because we, as planners, interact with many different people at various levels of understanding, the Resourcebook is written as much as possible in non-technical language.

The Resourcebook is the outcome of a research project funded by the Lands Directorate of Environment Canada. The project has involved nearly 90 people who practice, research, teach or study in the field of environmental planning across Canada. Over the past year, members of this carefully selected group gave generously of their time to review a draft of the Resourcebook, to share their experience and ideas at a two-day workshop in Toronto, and finally to document examples of their work for inclusion as case studies in this volume. Their contributions are gratefully acknowledged here and at the beginning of each section. The project also benefitted considerably from the assistance and support of Pierre Glaude, Neville Ward and Ed Wiken of the Lands Directorate.

The Resourcebook is organized into five chapters. There is a fair amount of overlap between them, reflecting the interrelated subject matter and the principle that environmental initiatives are more likely to succeed if they approach problems from a number of different directions at once. Chapter 1 provides a general discussion of the environmental perspective including environmental issues and the characteristics of environmental problems and planning. Chapter 2 examines environmental resources as components of the natural environment (with emphasis on the natural side of man-environment relationships). Chapter 3 considers selected environments, combining environmental resources in ways familiar to the average person, while Chapter 4 looks at selected activities (the perspective of proponent public and private agencies) likely to affect such environments adversely. Finally, Chapter 5 takes the planner's point of view by describing selected sets of environmental planning initiatives within a management framework. Throughout, brief case studies "ground" the text while information resources underpin it and direct the reader to further sources. Appendices outline how the research was conducted and list all those involved. In addition, addresses significant to environmental planners are provided, as well as a set of cross-referenced indexes.

Generally, the Resourcebook is aimed at generating communication between its users and environmental planners. A lesson might be taken here from ants, bees and termites which seem to accumulate intelligence as they gather together. Practitioners working alone or in small groups scattered across Canada can seldom assemble. But perhaps if linked through a network, their contributions could accumulate into a growing store of common knowledge. To that end, we dedicate this volume.

Reg Lang
Audrey Armour
Faculty of Environmental Studies
York University
August 1978

Meanings of Some Key Words

Tool: A physical or conceptual instrument used in analysis and planning. Examples: planimeter, table of random numbers, computer.

Technique: A way of or course of action for accomplishing a scientific or professional objective. Techniques are ways of using tools. Examples: sampling procedures, airphoto interpretation, soil testing.

Method: The way techniques are selected for use in planning and analysis. Techniques used by a planner are the result of the planner's *decisions*; the way these decisions are made is the result of the planner's *decision rules.* In other words, methods provide the rules of choice while techniques are the choices themselves. Examples of methods: McHarg's for environmental resource analysis (contrasted with Hills', for example), and Leopold's for environmental impact assessment (cf. Batelle). *Methodology* is the study of methods, not to be confused with the methods themselves.

Approach: A set of methods and principles directed towards a problem or class of problems. Approaches are guided by *theories* (sometimes explicitly, often implicitly) – organizing frameworks that explain certain phenomena and/or guide the planner in defining problems, selecting and applying approaches and methods, and prescribing solutions.

Paradigm: Laws, theory, applications and instrumentation combined and based on a value component acquired through professional or scientific training; a frame of reference or world view.

Adapted from: Russell L. Ackoff, *Scientific Method: Optimizing Applied Research Decisions* (New York: Wiley, 1962). On theory in action, see: Chris Argyris and Donald A. Schon, *Theory in Practice: Increasing Professional Effectiveness* (San Francisco: Jossey Bass, 1976). Paradigms are discussed at length in: Thomas S. Kuhn, *The Structure of Scientific Revolutions*, Second Edition (Chicago: University of Chicago Press, 1970).

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Chapter 1

1. The Environmental Perspective



The environmental perspective is a special way of looking at and seeing things. It carries a unique set of concerns which penetrate the roots of human existence and survival on this planet, and which reflect a special set of values whether implicit or out in the open.

This Chapter seeks to expose key aspects of the environmental perspective, first by examining general environmental issues, then by focusing on the nature of environmental problems, and finally by considering the *kind* of planning response these problems demand.

1.1 Environmental Issues

Environment surrounds. Each of us can say, "My environment is what surrounds me. By definition I am not part of my environment but I interact with it. I affect certain parts of it and certain parts of it affect me". However, *my* environment is not the same as *the* environment (in effect, the common environment). We are all part of *the* environment which comprises the animate and inanimate forms existing in various dependent relationships.

Homo sapiens are more than just one species among many in the environment. The size of the human population, its use of technology, the concentration of human activities and the spread of their effects, place man in an extraordinary position in the environmental scheme of things. The development of human cultures, together with their capacity to store knowledge and apply informed foresight to the conduct of human affairs, give man a unique capability to affect the environment and so, a responsibility to take purposeful collective action that may harmonize human existence with the rest of the environment.

Whether this capability and responsibility can or will be exercised is questionable. At least the demand to do so exists. Environmental problems, around for a long time, have recently graduated to the rank of issues (an issue being a special kind of problem characterized by urgency, differing and often conflicting points of view, and accompanying controversy). Popular environmental concern erupted in the sixties, peaked in the early seventies, has remained constant though less apparent, and now shows signs of a resurgence. Pollution focused public opinion in the sixties; energy and health may be the rallying cries of the late seventies and eighties. Today's big killer diseases, cancer and cardio-vascular disease, are now believed to be chiefly environmental and lifestyle in origin. Human health seems more and more at risk from air pollution, noise, congestion and other sources of stress. Effects of new chemicals in bewildering combinations threaten health, valued environmental resources, ecosystems, food chains and the genetic basis of life; difficulties of establishing clear cause-effect relationships only alarm people more. Meanwhile, many of the environmental problems of the sixties are still with us. Progress, such as reduced levels of SO_2 in most cities, was made early in the decade. But acid rain, the long-distance transport of air pollutants, and the probability of increased pollution from the burning of high-sulfur coal as oil reserves decrease, pose new threats. New pollu-

God created man in his image. In the image of God he created him. Male and female he created them. Then God blessed them and said to them, "Be fruitful and multiply; fill the earth and subdue it. Have dominion over the fish of the sea, the birds of the air, the cattle and all the animals that crawl on the earth . . . ."
The Book of Genesis, Chapter 1

God said, "Let the earth bring forth every kind of living creature: cattle, creeping things, and wild beasts of every kind". And it was so. God made wild beasts of every kind and cattle of every kind, and all kinds of creeping things of the earth. And God saw how good this was. And God said, "I will make man in My image, after My likeness. They shall rule the fish of the sea, the birds of the sky, the cattle, the whole earth, and all the creeping things that creep on earth".
The Torah

tants like PCBs are emerging in the form of wastes carelessly disposed of in the past, e.g. in sanitary landfills leaching out their hazardous contents to waterways. Such problems, if treated narrowly, will create new problems in the future. Increasingly, the chilling realization that real problems lie much deeper, that the solutions will be painful, is surfacing. Energy shortages signal something fundamentally wrong. Environmental, energy and associated economic and political ills may well be a single massive problem with a common set of causes. If pollution abatement merely treats symptoms, how can cures or prevention be achieved? Groping with this difficult question inevitably leads to basics. Why do environmental problems exist? Two decades ago the response might have been that technology and sufficient money had not yet been properly applied but soon would be. A decade ago fingers were pointed at villains – science and technology, the capitalist system, a shallow materialistic set of values supported by insatiable human needs, and the Judeo-Christian ethic which places man apart from nature and gives him dominion over it. But each of these "villains" is only a part of the problem; severe environmental degradation has been observed in cultures not dominated by high technology, capitalism, materialistic values or Judeo-Christian values. Berry and Horton argue that the primary cause of environmental disruption is industrialization under conditions in which environmental resources are undervalued. Dubos maintains that man has tended to exploit nature irrespective of religion or scale of industrialization (primitive societies also overgraze and slash-and-burn) perhaps because of ignorance and desire for short-term gain. Economists, observing the growing divergence between private ends and social goals, see a basic weakness in market systems which work fairly well in exploiting basic resources and in processing and distributing them but fail in the efficient disposal of residuals to common property resources, primarily because the latter are not "owned". And so on. There is no clear consensus on what the problem is, much less what its solutions ought to be.

Conflicts among land uses is another issue which has direct implications in meeting basic human needs such as food and shelter. Owing mainly to favourable combinations of climate, soil and topography, only about 2% of Canada's land mass is considered prime agricultural. These same areas are also favoured for human settlements as they possess the warmer climates and the site conditions which minimize building and maintenance costs. Such competitions for lands of limited quantity are antagonistic in the long term for Canadians.

Recently, a further aspect of environmental issues has become apparent: society and its institutions, founded on values and concepts that perceived the environment narrowly, are improperly organized to deal effectively with the issues that result. Environmental insults are institutionalized when one agency's output becomes another's input. Furthermore, organizational shortcomings contribute to environmental under-valuing. Negative feedback in the form of danger signals indicating corrective action needed to prevent permanent over-stressing of environmental systems, becomes obscured by complex institutional arrangements that increase the sense of separation from nature. We flush and forget.

Underpinning the institutional aspect of environmental problems and responses to them (including environmental planning) are certain outdated concepts of man and nature. An alternate perspective reflecting the inevitable interdependence of man *in* natural systems has been much written about and often discussed but has not yet been assimilated in everyday behaviour of organizations whose developmental or regulatory activities significantly affect the environment. Canadian-U.S. experience in cleaning up the Great Lakes (see Case Study 1) demonstrates that the outcome of environmental issues depends not only on what is done and how it is done but also on why it is being done. Obsolete concepts (in this case, the water-quality approach) guide current environmental practice and inhibit necessary integrative action.

At the peak of the environmental movement, perhaps Earth Day 1970, the real problem was how to get people and organizations to act. The problem remains. The call for more data and better methods often masks lack of willingness to make unpleasant decisions and postpones confrontation. This response to environmental problems is reinforced by fragmented institutional arrangements. A broader ecosystem concept, while obviously not sufficient in itself, is nevertheless an essential condition for improved understanding of man-dominated ecological systems and more effective action on environmental issues.

"Environment" itself may be an obsolete notion. It has been useful for coalescing public concern and communicating many inexpressible notions, and continues to serve this function. But the word "environment" implicitly separates us from those things upon which we depend. It has limitations as a concept for the kind of planning and management that cannot be fully effective until founded on man's inseparability from the rest of the biosphere.

Case Study 1
Great Lakes Basin:
A New Concept Needed

The Governments of Canada and the United States agreed, in the 1972 Great Lakes Water Quality Agreement, to develop and implement programs and other measures to restore and enhance the water quality in the Great Lakes System. The Agreement, based on the earlier Boundary Waters Treaty of 1909, takes a water-quality approach which, according to the Great Lakes Advisory Board, is now obsolete.

A *system-external-to-man* concept underpins the water quality approach which sets limits not to be exceeded for certain chemicals in water, based on the most sensitive uses of it. Interactions within the ecosystems or of stressors external to water are not fully taken into account, a result of viewing man separate from nature rather than man in interaction with other parts of nature. The Board feels that focusing narrowly on water tends to be curative rather than preventative and comes too late. Virtually all transboundary problems originate on land from human activities, driven by the interwined forces of increased population growth and rising per capita consumption of resources, yet these primary stressors on the ecosystem are off limits to a discussion on water quality. For example, *acid rain* caused by human activities adds sulfur and nitrogen oxides to the atmosphere producing sulfuric acid which attacks organisms and property and acidifies poorly buffered lake waters. Acid rain is an element of the problem of long-distance transport of air pollutants. Although hardly detected in the Great Lakes (and therefore outside water- quality concerns) it is a major and growing problem in the Basin. Another example is *road salt.* Every person in the Basin uses 80 kg (170 lb) annually, creating costs of $5.2-7.4 billion per year (equivalent to 5-10 times the cost of operating sewage treatment facilities in the Basin) in return for dubious benefits. It too lies outside the Commission's domain; however the Board notes that it is in everyone's interest generally, to promote reduced use of road salt. A water-quality approach, accepting the driving forces of increasing population and rising per capita consumption, as given, regards the foregoing costs as "external". It cannot, therefore, take them into account.

The Board's preferred alternative, an ecosystem approach, would be based on a *man-in-a-system* concept that views man as part of nature. It would recognize the Great Lakes as an ecosystem composed of the interacting elements of water, air, land and living organisms including man, within the Basin. Such a concept would also necessitate explicit recognition of exchange of materials such as atmospheric pollutants into and out of the Basin, in the perspective of the biosphere (the outer sphere of the earth that is inhabited by living organisms). It would relate the biological and technological activities of man to the carrying capacity of the ecosystem, linking the human body to the biosphere. Carrying capacity, the notion that there are limits to the abundance and activities of particular species at certain times and locations, would apply not just to number of people but to population and technology combined. Together they are responsible, for the dramatic increase in the environmental stress characteristic of the past three decades (see 2.7 Natural Environments and Human Activities).

The Board argues that considering the Basin ecosystem rather than just water quality, would permit environmental problems to be addressed much more fundamentally. Such an approach would require people and organizations to speak of discharging wastes into the ecosystem and biosphere of which we are a part rather than to an external environment around us. The way might be opened for awareness and reduction of "hidden" costs because they would no longer be hidden. Adoption of an ecosystem approach to environmental management in the Great Lakes promises an incentive for managers to think beyond narrow objectives in isolation, while exposing the further hidden costs of piecemeal planning and management.

Refer to: Great Lakes Research Advisory Board, *The Ecosystem Approach: Scope and Implications of an Ecosystem Approach to Transboundary Problems in the Great Lakes Basin,* International Joint Commission (100 Ouellette Ave., Windsor, Ont. N9A 6T3), July 1978, 44 pp. Free.

. . . for we must believe, first that plants exist for the sake of animals, second that all other animals exist for the sake of man, tame animals for the use he can make of them as well as for the food they provide; and as for wild animals, most though not all of these can be used for food or are useful in other ways; clothing and instruments can be made out of them. If then we are right in believing that nature makes nothing without some end in view, nothing to no purpose, it must be that nature has made all things specifically for the sake of man. This means that it is part of nature's plan that the art of war, of which hunting is a part, should be a way of acquiring property; and that it must be used both against wild beasts and against such men as are by nature intended to be ruled over but refuse; for that is the kind of warfare which is by nature right.
Aristotle, *The Politics,* about 330 B.C.

Today, thanks to better sanitation and antibiotics and vaccines, Americans have less cause to worry about death and disability from infections and communicable diseases and more to be concerned about what may happen to them as the result of exposure to other external factors of many kinds. And whereas the "oldfashioned" environmental enemies typically went about their deletrious business singly and swiftly, the newcomers often join forces and stealthily may take years to take their presence felt . . . virtually all chronic diseases of unknown or uncertain origin can be blamed at least in part on the environment – on exposure to toxic agents or environmental stresses.
U.S. Dept. of Health, Education and Welfare, Second Task Force on Research Planning in Environmental Health Science

Information Resources

See also:
1.2 Characteristics of Environmental Problems
1.3 Characteristics of Environmental Planning
2.7 Interrelationships

Barney, Gerald O. (ed.). *The Unfinished Agenda: The Citizen's Policy Guide to Environmental Issues.* New York: Thomas Y. Crowell, 1977. Paperback, 184 pp. $3.95.

Berry, Brian J.L. and Horton, Frank E. *Urban Environmental Management: Planning for Pollution Control.* Englewood Cliffs, NJ: Prentice-Hall Inc., 1974. Hardcover, 425 pp. $16.50.

Topics covered include environmental beliefs and perceptions, environmental effects of urbanization, the nature of air pollution, managing the air resource, the nature of water pollution, water-resource management, assurance of municipal water supplies, solid-waste management, noise pollution and abatement strategies, environmental pollution and human health, and governmental (U.S.) programs affecting environmental quality.

Caldwell, Lynton K. *Environment: A Challenge to Modern Society.* Garden City, NY: Anchor Press/ Doubleday, 1971. Paperback, 301 pp. $3.25.

An earlier, influential book by a social scientist that persuasively articulates the need to factor environmental concerns into public policy.

Commoner, Barry. *The Closing Circle: Nature, Man and Technology.* New York: Bantam Books, 1972. Paperback, 343 pp. $1.95.

This book documents the environmental crisis at the peak of popular environmental concern. It examines the ecosphere, nuclear power, air and water pollution, soil contamination and other environmental problems before turning to their root causes. Commoner's argument (by contrast with Ehrlich's, below) is that population growth is less of a contributing factor than increased use of resources. He considers how human activities generate environmental impacts, i.e. external intrusions into the ecosystem which tend to degrade its natural capacity for self-adjustment and notes that most pollution problems appeared or worsened after World War II. Substitution of environmentally benign technologies for environmentally stressful ones (e.g., soap replaced by detergents), dramatic increases in consumption (wealth caused by rapid short-term exploitation of the environmental system) and science's fragmented reductionist treatment of ecosystems are identified as central causes of environmental damage. Underlying social, economic and political issues are explored. Commoner concludes by arguing that the environmental crisis is the product not of man's biological capabilities but of his social actions which are more amenable to being changed. Social organizations devised to conquer nature have broken out of the ecological cycle of which man is an inseparable part. To survive we must close the circle.

Commoner, Barry. *The Poverty of Power: Energy and the Economic Crisis.* New York: Bantam Books, 1977. Paperback, 296 pp. $2.75.

Annotated in 2.7 Energy.

Dasmann, Raymond F. *Environmental Conservation.* 3rd Edition. New York: Wiley, 1972. Paperback, 473 pp.

Examines a broad spectrum of environmental and human problems from an ecological viewpoint. "The human environment" is made up of the natural resources of the earth, both renewable (mainly biotic and interrelated) and non-renewable (mainly abiotic), together with man's cultural modifications of them. The problems of the human environment are said to derive from population growth, inappropriate application of technology and lack of control over land use. "Conservation", defined as the rational use of the environment to provide a high quality of living for mankind, involves the planning for and control of man's use of his environment with consideration for the long-range future of the human race and a view to providing environments suitable to the satisfaction of the widest possible range of human aspirations. "It involves, therefore, the preservation or creation of diversity in environments, maintaining the greatest variety of living creatures, in order to provide suitable habitat for the varied types of people that still exist and thus to enable this human diversity to survive." Dasmann first examines the nature of the environment, then turns in successive chapters: the world's major biotic regions; the environmental record of human habitation on the planet; the concept of conservation; soil, agriculture and world food supplies; civilization and water; forests and timber; livestock on the range; wildlife management; the aquatic environment; the urban environment; the problem of population; the need for energy; the need for minerals; taking action for conservation; and vanishing heritage.

Dubos, René, "Commentary: Man's Attitude Toward Nature," in Smith, R.L. (ed.). *The Ecology of Man: An Ecosystem Approach.* New York: Harper and Row, 1976.

Eckholm, Erik P. *The Picture of Health: Environmental Sources of Disease.* New York: W.W. Norton, 1977. Paperback, 256 pp. $4.55.

A forceful analysis of the environmental origins of world health trends. Eckholm argues that our health is influenced less by doctors, drugs and spiraling medical expenditures than by our social and physical environments. "Indeed, in creating its way of life, each society creates its way of death".

Ehrlich, Paul R. and Anne H. *Population, Resources, Environment: Issues in Human Ecology.* Second Edition. San Francisco: W.H. Freeman and Co., 1972. Hardcover, 509 pp. $14.00.

In contrast to Commoner, above, the Ehrlichs in their discussion of "the environmental crisis" place primary emphasis on numbers of people. They conclude that: the planet is grossly overpopulated now; large numbers of people and the rate of population growth are major hindrances to solving human problems; the limits of human capability to produce food by conventional means have nearly been reached (problems of supply and distribution have already resulted in half of humanity being undernourished or malnourished and 10-20 million starve to death annually); attempts to increase food production further will accelerate environmental deterioration and further reduce the Earth's capacity to produce food; population growth increases the probability of lethal worldwide plague and thermo-nuclear war (two "death solutions" to the problem). Solutions to the complex of problems comprising the population-food-environment crisis do not lie in any technological panacea, although properly applied technology (pollution abatement, communications, fertility control, etc.) can provide massive assistance. Solutions must involve dramatic and rapid changes in human attitudes especially toward reproductive behaviour, economic growth, technology, the environment and conflict resolution.

Heilbroner, Robert. *An Inquiry into the Human Prospect.* New York: W.W. Norton, 1975. Paperback, 180 pp. $2.50.

A brief but thoughtful exploration of the "global predicament of man today, confronted with runaway population growth, obliterative weaponry and a closing environmental vise". The prospect foreseen by the author is an extended and growing crisis induced by the advent of a command over natural processes and forces that far exceeds the reach of our present mechanisms of social control. Affluence is not the answer because "it may only permit larger numbers of people to express their existential unhappiness because they are no longer crushed by the burdens of the economic struggle." A more likely prospect is "sustained and convulsive change as the inescapable lot of human society for a very long period to come". An orderly response to social and physical challenges is likely to require an increase in centralized power and the encouragement of national (rather than often called-for communal) attitudes.

Laszlo, Ervin et al. *Goals for Mankind.* New American Library, 1978. Paperback, 374 pp. $2.50.

The fifth in the familiar series of reports, "The Predicament of Mankind", to the Club of Rome (the earlier ones were: D.L. Meadows et al., *Limits to Growth*; M. Mesarovic and E. Pestel, *Mankind at the Turning Point*; J. Tingergen, R10: *Reshaping the International Order*; and D. Gaber et al., *Beyond the Age of Waste.*) This book concentrates on goals: what they are and ought to be for mankind, whether nations will be able to effect the radical changes in structure and behaviour necessary to put the global house in order, how to deal with the gaps between short-term issues and long-term needs, conflicts between developing and developed nations, changing patterns of interdependence and so on. Part 1 overviews current goals of today's world; Part 11 gives a basic assessment of a variety of global goals; and Part 111 reviews the relevance of the great religious and modern world views to the issue of "inner limits" vs. world solidarity.

Leiss, William. *The Domination of Nature.* New York: George Braziller, 1972. Hardcover, 242 pp. $7.95. Paperback (Beacon Press, 1974), $3.95.

This book describes the circumstances in which modern versions of the idea of "man's conquest of nature" first arose, how it became associated with the achievements of science and technology, and why it became such a powerful ideology in our society. Part One sketches the idea of the domination of nature from the Renaissance to the present when it is firmly identified with scientific and technological progress. Part Two analyses the role of science and technology. In the concluding chapter the author places the new understanding of mastery over nature into an overall historical perspective. He explores a new approach based on "the liberation of nature" and mastery not of nature but of the relationship between nature and humanity.

Livingston, John A. *One Cosmic Instant: A Natural History of Human Arrogance.* Toronto: McClelland and Stewart Ltd., 1973. Hardcover, 243 pp. $7.95. Paperback (Dell, 1974), $2.75.

"Contemporary Western man in the overwhelming majority considers himself fundamentally different and distinct from the living world which gives him both substance and sustenance. This imagined separation between man and 'nature' has provided the conceptual framework for a further doctrine, that of absolute human power and authority over the nonhuman". Proceeding from this premise the author sets out his personal philosophy urging adoption of an ethical relationship between man and his environment. We cannot change our biological inheritance but we can and must consciously change our culture. A new and unprecedented humility is needed (which, according to Josef Pieper in *The Four Cardinal Virtues,* is simply man's estimation of himself according to truth) toward the cosmos of which we are an integral mortal part and a willingness to see ourselves in the perspective of infinite time and events of unimaginable magnitude.

Miller, G. Tyler, Jr. *Living in the Environment: Concepts, Problems and Alternatives.* Belmont, CA: Wadsworth Publishing Co., 1975. Hardcover, 609 pp. $16.50.

A text in two parts. First, 20 chapters cover ecological principles and their application to major environmental problems (population, resources and environment, human impact on earth, energy, ecosystems, human population dynamics and control, urban and non-urban land use, resource depletion, water resources, air and water pollution, economics and environment, politics and environment, and environmental ethics). Then twenty "enrichment studies" expand on various topics (climate change, limits to growth, population and birth control, ecology and the poor, pesticides, noise, aesthetics, solid wastes, nuclear energy, endangered species, heavy metals, human disease, agricultural pollution, social problems, air pollution control, the automobile, food additives, exerting political influence, and solar energy). An extensive bibliography and glossary are included.

Odum, Eugene P. *Fundamentals of Ecology.* Third Edition. Philadelphia: W.B. Saunders, 1971. Hardcover, 574 pp. $14.95.

Still a basic text in ecology.

Ophuls, William. *Ecology and the Politics of Scarcity.* San Francisco: W.H. Freeman, 1977. Paperback, 303 pp. $6.95.

A provocative critique of (American) political values and institutions which the author claims "are grossly maladapted to the era of ecological scarcity that has already begun". Major sections are: ecological scarcity and the limits to growth; the dilemmas of scarcity; and learning to live with scarcity.

Sills, David L., "The Environmental Movement and its Critics", *Human Ecology,* Vol. 3, No. 1, 1975, pp. 1-41.

A comprehensive overview of the history and nature of the environmental movement in the United States. Since understanding of a social movement is enhanced by learning the views and perceptions of outsiders, the continuing debate between the environmental movement and its critics is examined. First, disagreements over the nature and the severity of the "environmental crisis" are described. Next, ideological differences between environmentalists and their critics are reviewed, particularly from the contrasting interests of man, society, nature and economic growth. Finally, the political critique of the movement receives attention, especially the composition of its membership, the alleged superficiality of its proposed solutions to environmental problems, and the discrimination it is claimed to show against poor people and nations.

U.S. Dept. of Health, Education and Welfare. *Basic Concepts of Environmental Health.* National Insititute of Environmental Health Services (P.O. Box 12233, Research Triangle Park, NC 27709), 1977. 43 pp. Free.

A summary of the full report of the Second Task Force on Research Planning in Environmental Health Science, *Human Health and the Environment – Some Research Needs,* 1977, is also available from the Institute. The summary discusses problems in environmental health, general atmospheric pollutants, food, water and multiple sources, selected problems of special environments (neighbourhood, home, hospital, etc.), physical environmental factors, transport and alteration of pollutants, waste disposal and natural sources of toxicants, environmental measurements of chemicals for assessment of human exposures, enviromental forecasting and technology anticipation, biological mechanisms and determinants of toxicity, carcinogenesis and mutagenesis, reproduction, teratology (the science or study of monstrosities or malformations in animals or plants) and human development, behavioural and neurologic toxicity, organ systems, environment and disease, methods and resources for estimating disease risk in humans, and professional and scientific education and personnel.

1.2 Characteristics of Environmental Problems

Acknowledgements 1.2

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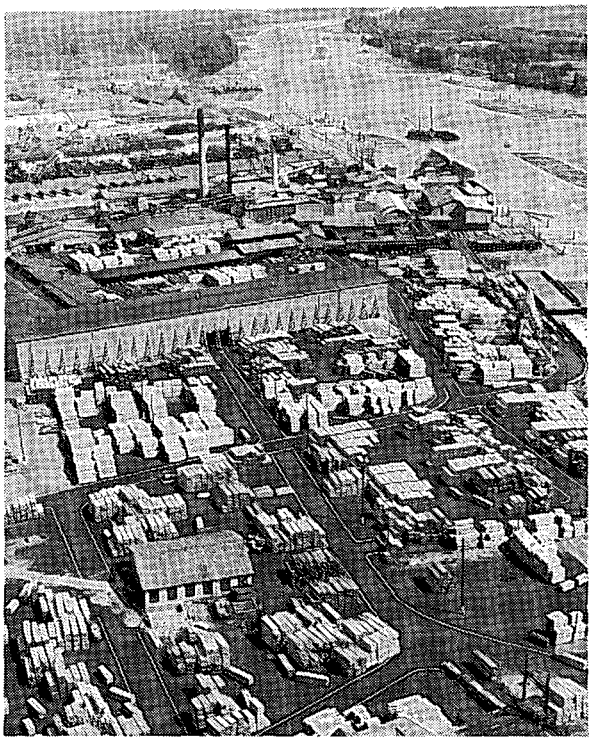
A problem is a gap between what is and what ought to be, between what we have and what we want or can reasonably hope to achieve. Problems are needs perceived to require action.

Perception plays an important role in environmental problem-solving and planning. Decisions to change an environment are based less on the environment as it is than on the environment as it is perceived by the decision-maker. *Perception* refers to an individual's immediate evaluation or reaction when confronted with a reality while *image* refers to the picture of reality, not necessarily more accurate, that an individual forms after deliberation. The perceptions and images people have of the environment are factors in the decisions they make concerning the environment. As Found notes with respect to natural hazards such as flooding, earthquakes and avalanches:

> *Studies have shown that human perception of hazards is a function of personality and culture (prior learning experiences therefore). Some people view nature as a neutral agent which undergoes normal variations in 'providing' catastrophies. Others see nature as a benevolent agent or an opponent, helping or frustrating man's actions. Some groups perceive man as totally subject to the whims of nature; others see that man can work with or control nature to suit his needs.*

The environment as perceived, then, is the basis for environmental problem-definition, which in turn affects both the *range* of possible solutions available and the kinds of *strategies* appropriate to solving such problems. For example, a solid waste problem defined as "how to dispose of garbage effectively" would produce a different set of solutions if the problem were seen as "how to reduce the amount of garbage requiring disposal". The cultural context (collective and long-standing perceptions), the various interests involved in the problem, and the various solutions that seem to be available all affect the final outcome.

Environmental problems have certain additional distinctive characteristics, both substantive and procedural, which further influence the range of solutions and strategies available.



Substantive Characteristics of Environmental Problems. Garrett Hardin captured a disturbing feature of many environmental problems under the heading "Tragedy of the Commons". He demonstrated, as summarized below by Hall, that mankind cannot continue indefinitely to increase its consumption of the world's finite resources.

> *The classical English pattern of using the village commons (communally owned and used land which was available for pasturing* private *livestock) did not involve a conflict between public and private welfare as long as there was enough land. However, as herds increased, the overgrazed land became less productive, so that herdsmen had to increase their stocks in order to stay even, and thus the commons were destroyed. The tragedy was that profits accrued to the most opportunistic herdsmen who exploited the commons the most, while losses were shared by* all *the users. Those who exercised restraint were doubly penalized. Not only did they suffer losses from the overgrazing of neighbours but they were unable to exploit the market by means of their own production.*

> *Today the sea, the air, the waterways, the earth, the land and what it produces have all become commons, and* all *are vulnerable to overuse. Appeals to altruism are futile, and in one sense foolhardy. Technology alone will not get us out of this dilemma because these are human problems.*

Environmental problems can be viewed as problems of *externalities*, that is, effects not dealt with in market transactions. The neighbour playing his stereo loudly, the industry spewing pollution into the air and the extra fisherman who reduces everyone's catch from the lake are common examples. The agent creating an externality problem suffers a negligible, perhaps zero, share of the effects he causes. His incentive to change his behaviour is correspondingly minimal. Externalities, as goods with no identifiable owner, appear to have no costs associated with their use. The buyer becomes bargain-hunter (to use Schumacher's term). Consequently, when solutions are sought to environmental problems and alternate uses of an environmental resource are compared (e.g., using a river for industrial and urban sewage or as a scenic recreational area and habitat for non-human life) environmental externalities tend to be left out of the cost-benefit equation. Sudia makes this point with respect to rivers:

> *Only when the cost-benefit ratio is calculated on single uses does the open sewer concept appear to have merit and only then because the river is deemed to have no value. For instance, the comparative cost between allowing industrial wastes to enter the river or building industrial water treatment plants is clearly in favor of the former. But if the cost of treating the municipal water supply – essential when the water is industrially polluted – is considered, the balance moves in the other direction. If the cost of illness and disease, the value of wildlife, and the value of hard cash-on-the-barrel recreational potential is included in the equation, the cost-benefit ratio tips further away from the use of the river as an industrial and municipal sewer.*

A factor in permitting wastes to be regarded as external to an industry's, city's or individual's operation is the prevailing view of government's role. Where this role is seen to be merely supportive of the private sector, which in turn is perceived to carry the main burden of building and operating the society, firms and individuals can feel free to disregard the external effects they create. Their outputs merely become government inputs (for example, one province, anxious to obtain a major pulp and paper mill, agreed to assume all responsibility for the plant's waste – a decision the government was later to regret). Often, both industry and government have disregarded adverse environmental effects, seeing them as "natural" or as the price of progress. Environmental irresponsibility was thus institutionalized.

For some time now, these views have been changing, partly in response to the dramatic increase in popular concern over environmental quality. Governments have expanded their regulatory and developmental roles accordingly. But the interests of the "total ecological community" continue to be ignored in favour of some of its components, and the cost-benefit ratio for despoilation of the environment continues to favour single or a few individual users. This can be partly explained by certain additional characteristics of environmental problems which make them difficult to handle by conventional approaches to problem-solving, including the following:

> *Dispersion of effects.* Large distances frequently separate effects from sources. Water pollution in the Great Lakes is an obvious example. Another is roadside residents who are subject to pollutants and noise by passing automobiles. Discovery of DDT in penguin eggs is an outstanding example of the dispersion of effects over both distance and time. They show up most in "downstream" communities – those at the end of watersheds, airsheds and the like. Such communities are the counterpart of a species being at the end of a food chain. Identifying responsibility and ensuring accountability become major problems.

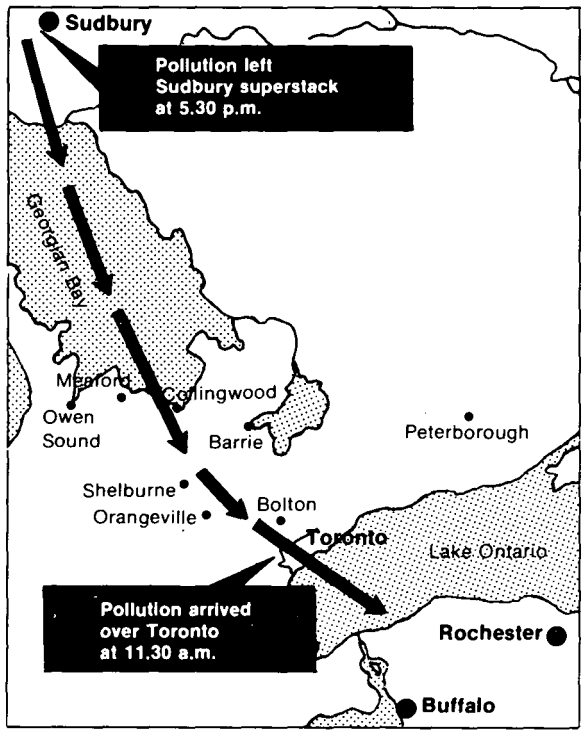


Figure 1.1 Long-Distance Transport of Air Pollutants: An Example

Source: Ross Howard, "Inco's fumes are tracked to Toronto", *Toronto Star*, 12 August 1978. The article reports the results of attempts, by the Atmospheric Environment Service of Environment Canada, to follow the sulfur dioxide plume from the giant Inco plant in Sudbury to the metro Toronto area some 400 km (250 miles) distant. The plant is equipped with a "superstack" 387 m high, designed to disperse the industrial pollutants away from the Sudbury area.

Inequities. Although pollution tends to disperse, profit and other benefits tend to concentrate. Inequities develop between those who reap the benefits of exploiting the environment as a free commodity and those who bear the cost – often the poor or otherwise already-disadvantaged groups. The ability to externalize costs, something the more powerful and affluent are better equipped to do, produces the not-in-my-backyard syndrome. Its' accompanying problem is where to locate services and facilities which are essential to society's functioning (garbage dumps, for example) but which are universally unwanted in close proximity. A similar conflict arises between those who would pursue jobs and economic benefit with associated environmental cost, and those (usually farther away) who favour other options. Another kind of inequity is transgenerational, between those who create costs now (e.g., producing radioactive waste) and those who will have to bear them in the future.

At the larger scale, people from less developed areas in Canada and throughout the world may resent standards imposed on them by more developed areas. The former feel that they shouldn't be required to pay for the mistakes of the latter; that they have a right to make their own mistakes. To areas anxiously seeking development, environmental degradation may appear to be a sign (perhaps even a necessary condition) of economic progress. Standard of living and level of affluence across the country or around the world vary more than people's aspirations.

The Cosmic Calendar

Most of us measure time in days, months and years or, at most, generations. Human history is recorded by centuries and millennia. But these are miniscule time periods when compared with the time that the earth has existed – long before there were written records, going back to the "Big Bang" that involved all matter and energy in the present universe.

Sagan has recreated a "cosmic calendar" to express this chronology. It compresses the universe's existence into a single year. Every one of the 15 billion years of Earth history corresponds to about 24 days, and one second of that year becomes equivalent to 475 real revolutions of the Earth around the sun. Life on earth originated about 25 September of that year. Man did not appear until 10:30 pm on 31 December. Dinosaurs came on Christmas Eve and were extinct three days later.

Inspection of the cosmic calendar is a humbling experience. All recorded history occupies the last 10 seconds of New Year's Eve and the time from the Middle Ages to the present is a mere second. Sagan concludes, "Despite the insignificance of the instant we have so far occupied in cosmic time, it is clear that what happens on and near Earth at the beginning of the second cosmic year will depend very much on the scientific wisdom and the distinctively human sensitivity of mankind".

See: Carl Sagan, *The Dragons of Eden: Speculations On the Evolution of Human Intelligence* (Ballantine Books, 1978), paperback, 271 pp., $2.25.

Time lags and lack of negative feedback. Planners normally see themselves working in the medium to long-term future. For some environmental time horizons this is insufficient. Biological cycles are much longer than the usual 10-20 year planning periods and geological cycles are very much longer. Health effects induced by environmental contaminants often take a generation or more to surface; meanwhile, other changes occur and cause-effect relationships become exceedingly difficult to establish, expecially if they require the degree of certainty demanded by the courts. When negative feedback is missing, predictions warning of future ill-effects tend to be ignored, particularly in urban-industrial areas where the kind of feedback needed for stability and continuity of ecosystems has been over-ridden by technological means. By the time these effects become apparent and it is obvious that technological solutions also have serious adverse effects, it may be too late. The current profligate attitude toward energy consumption, in the light of predicted severe shortages only 10 or 15 years from now, is a timely example.

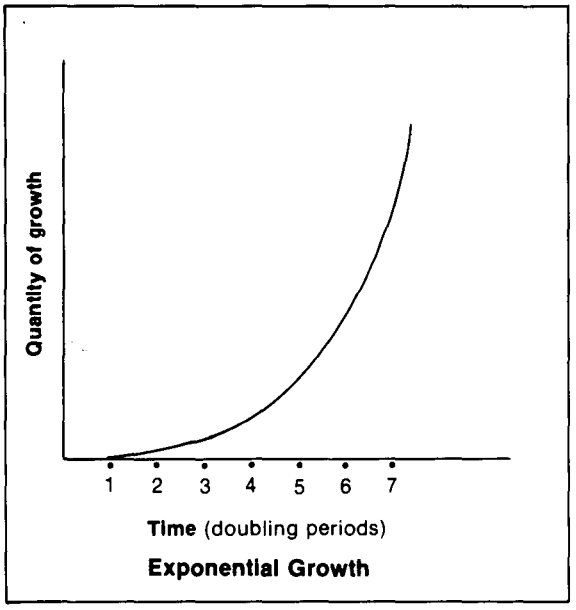


Figure 1.2 Exponential Growth

Exponential growth. The poorly understood nature of exponential growth contributes to environmental problems. Lester Brown draws from a French riddle, the 29th day, to illustrate this phenomenon. A lily pond contains a single leaf. Each day the number of leaves doubles – two the second day, four the third, and so on until on the 30th day the pond is full. At what point is it half full, giving warning of imminent congestion? On the 29th day.

The various "lily ponds" upon which mankind depends, including the globe on which four billion of us live, may already be half full, with little time left for response. In a society oriented to responding only when crisis is at hand (that is, when people are demanding action and there is little likelihood of making political mistakes that will displease too many of them) the problem is how to generate corrective and preventive action well before the 29th day. Caldwell argues that we have lost whatever intuitive ecological wisdom our ancestors had but have not yet adequately benefitted from environmental science.

Cumulative effects. Focusing attention on a single project or effect can overlook incremental environmental changes which slowly add up. The environmental quality of urbanizing areas is lost by attrition, and people tend to adapt to environmental change that is slow and disjointed.

Synergistic effects occur when two or more substances interact to produce effects they are incapable of producing alone. For example, traces of sulfur dioxide and nitrogen oxides individually may not be harmful; but together, when converted in the presence of photo-chemical energy and atmospheric water vapour to form smog, their danger is much greater. At the individual level, both asbestos and cigarette smoke can produce lung cancer independently but the rate of lung cancer among smokers also exposed to asbestos is higher than would be expected from either risk alone. Mere information of these probabilities, however, is seldom sufficient to stimulate corrective action. Smoking and radioactivity are also synergistic but campaigns to encourage workers in uranium mines to stop smoking have reaped only limited success.

Environmental ignorance and lack of popular/political support. Much is known about environmental systems and much is not known about them. But lack of knowledge and information is only one aspect of the problem. Ignore-ance, overlooking, not acknowledging or remaining blissfully unaware of what *is* known, is another.

Table 1.1 Environmental Issues Ranked Among Municipal Priorities

In a cross-Canada survey conducted in early 1976, municipal-government respondents (senior elected and appointed officials) were asked to rank in order of importance a set of "local issues". The results follow. It should be noted that: a. interpretations of what is included in "environment" varied (respondents tended to perceive it narrowly in terms of aesthetics, water and air quality, noise, waste disposal and preservation of historic sites, seldom mentioning wildlife protection, preservation of prime agricultural land or energy conservation); and b. the public, as other surveys have indicated (e.g., Resources for the Future) may wish to give environmental matters considerably higher priority than is suggested here.

Most important	1. Finance
	2. Sewer and water services
	3. Land use
	4. Housing
	5. Education
	6. Transportation
	7. *Environment*
	8. Welfare
Least important	9. Other (e.g., recreation)

Source: Reg Lang and Audrey Armour, *Urban Environment Assessment in Canada and the United States* (Ottawa: Ministry of State for Urban Affairs, June 1976), unpublished, Appendix A.8. The results, above, are based on a questionnaire on environmental concerns in municipal government mailed, with the cooperation of the Canadian Federation of Municipalities, to mayors of the 168 municipalities with population over 5 000 (31.5% response).

People and organizations do not readily perceive relationships between their individual and collective actions, on the one hand, and loss of environmental capacity or quality on the other. Mechanisms seldom exist to obtain and disseminate this information, or provide negative feedback necessary to "close the circle" on putting the water intake of all industry and municipalities downstream from their sewage outfalls. Preventive action to enhance environmental capacity and quality tends to be limiting, and it is oriented to future rather than more-tangible present gain. Environmental quality may be valued by most people in one way or another (as newspaper ads for urban ravine lots and lake-fronting summer properties readily indicate) but it lacks a solid vocal constituency to advocate on its behalf. We care more about the environment we own than the environment that collectively is ours. For these reasons and others, environmental quality in most parts of Canada tends to receive low political priority. Environmental issues are rarely prominent in provincial and federal elections and only recently, and sporadically have they become significant municipally. Public outcries over specific environmental degradations are scattered and brief. Many of our laws are inadequate in dealing with environmental concerns. Legal defensibility of environmental planning measures is a central problem and laws that do exist are inadequately enforced (Swaigen). Organizational structures seldom reflect the realities of environmental systems and environmental programs frequently struggle along on minimal budgets. A self-reinforcing cycle results: low-priority programs deliver little and so continue to receive low priority.

Procedural Characteristics of Environmental Problems. Procedural characteristics refer to how environmental problems are approached and handled. Much of this is covered in Sections 1.3 and 5.1. The focus here is on a central feature of environmental problems, which can be stated as a dilemma:

> Environmental systems function in an interdependent holistic manner, whether we perceive or act on them that way or not, But institutional systems expected to deal with environmental problems are separate, compartmentalized and often disjointed, and the interests affected by these problems and their solutions are often in conflict.

Institutions (governments, for example) seem unable to deliver the kind of integrated action that interdependent environmental systems demand. Acting on only one part of an interdependent system inevitably produces problems elsewhere. Yet we lack the comprehensive understanding of environmental-system functioning; many environmental effects simply cannot be predicted to the extent necessary for an overall "comprehensive environmental plan". The corresponding degree of central control needed to carry out such comprehensive plans effectively is similarly lacking, and understandably so. Environmental problems rarely respect jurisdictional boundaries and it is impossible to set up a separate agency for every environmental system or a single agency for all environmental systems. Even if this were politically feasible, the agency would be huge, necessitating the existence of sub-agencies with insurmountable coordination problems. Because *both* comprehensive understanding *and* integrated action are necessary and yet not fully possible, "dilemma" correctly describes this situation.

One response is to focus heavily on one side of the dilemma and suppress concern for the other or hope it will resolve itself. This happens when persons trained in comprehensive disciplines, such as ecologists or urban/regional planners,

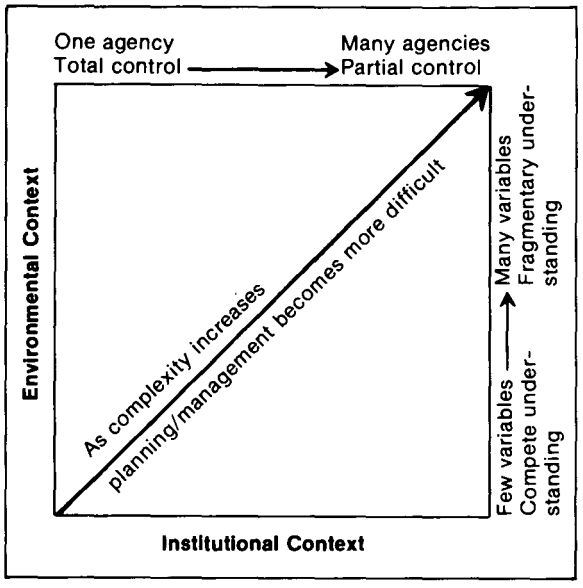


Figure 1.3 Environmental vs. Institutional Context

insist that comprehensive understanding of environmental problems, accompanied by holistic long-term data bases, must precede comprehensive environmental plans which in turn must be the guiding frameworks for implementation. A hidden assumption is that if such data bases and plans are well done they will be so powerfully persuasive that top decision-makers will accept them, over-ride conflicting interests and compel the various implementing agencies to carry out the plan. It seldom happens. On the other hand, persons such as political scientists and lawyers, whose backgrounds are more oriented to institutional responses, focus on incremental action (getting things done) with only limited relationship to the larger picture and rarely with strong sustained environmental concern. The typical result: a specific problem solved, a new organizational structure formed, a program launched, an Act amended, and so on. Both the advantages and shortcomings of this piecemeal approach are readily apparent.

Avoiding the dilemma means keeping away from the extremes of either opposing position, such as a sequence of plans never adopted or the chaos of continuous reorganization. This requires the formulation of strategies that borrow the best features of each—selective use of the comprehensive approach, and incremental action within a larger but adaptive framework – congruent with:

1. *The degree of understanding of environmental systems.* Some are relatively simple; the receiving environment and the impacts of proposed activities are fairly well known. At the other extreme, environment and impacts are highly complex and poorly understood. Only in the former situation is the blueprint-type plan feasible. In the latter, a flexible exploratory approach is essential.

Environmental Context	Institutional Context	Example	Approach
Simple	Simple	Forest products industry that controls its use of needed resources and limits its concern to harvesting timber.	Data base dictated by project requirements. Blueprint-type plan and implementation strategy (e.g. PERT).
Simple	Complex	Hydro company building transmission line cutting across numerous jurisdictions and affecting various interests. Environmental concern limited.	Data based on project requirements but plan must be flexible allowing for negotiation and coordination with other agencies/ interests.
Complex	Simple	Highways Dept. concerned with environmental effects but able to implement any plan it determines (i.e., powerful dept., no public participation).	Data base as comprehensive as time and resources permit. Comprehensiveness of plan limited by environmental unknowns; monitor results carefully for unforeseen effects.
Complex	Complex	Municipality with limited powers undertaking environmentally sensitive area program with full public participation.	Reduce either environmental or institutional complexity first (e.g., studies for the former, negotiated agreements for the latter), then proceed as above.

Figure 1.4 Approaches to Varying Environmental and Institutional Complexity

DRT

2. *The degree of control over implementing actions.* Similarly, where a single agency does the planning and has total or near-total control over actions to implement it, the blueprint-type plan is appropriate. Not so at the other extreme where numerous actors sharing implementing functions may or may not go along with any plan made, and where influential interest groups affected by the planned action add to the complexity.

Degree of understanding of the environment and degree of control over implementing action, ranging from simple to complex, combine to form a spectrum of situations which have to be matched by a similar range of appropriate planning/management responses. The greater the complexity, the more flexible and adaptable the approach required to achieving integrated action.

The key lies in the handling of complexity (Mack). It can be both over- and under-estimated, with unhappy results. Some solutions to problems require only a limited understanding and a modest amount of agreement among the key actors – no need to make things more complicated than they are. Many situations environmental planners face, however, lie in the upper right-hand corner of Figure 1.3, that is, very partial understanding and only limited control. Trying to deal with all this complexity at once can be futile. It may be necessary to admit only one kind of complexity at a time – environmental *or* institutional – and work to reduce it to manageable proportions before turning to the other. For example La Société de Développement de la Baie James first negotiated Indian land claims and secured the powers of a municipality within its territory; this enabled it to address planning its resource use from a complex, ecological perspective. Figure 1.4 gives some further instances of varying environmental/institutional combinations and planning responses to them.

Substantive and procedural characteristics of environmental problems are reflected in the environmental planning and management applied to them. Recognizing the distinctive features which environmental issues impose on planning/management processes helps practitioners to cope and allows them to transfer knowledge gained from one setting to another.

A final question confronting environmental planners in Canada concerns the extent to which environmental problems in this country are distinctively Canadian and how that must be reflected in their solutions. Margaret Atwood, from a poet's perspective, feels that Canadians demonstrate in their literature their own peculiar view of nature in relation to (wo)man. Beyond that, Canadian environmental problems, spread over a vast and diverse territory, are characterized mainly by their variety. Still, they are not unlike the problems of other nations with cold/temperate climates experiencing urban industrialization and a high-consumption lifestyle. Procedurally, however, Canadian environmental problems as a whole are as distinctive as the political-cultural system which spawned the institutional arrangements to deal with them; their differences across the country mainly reflect differing jurisdictional and cultural settings.

The main features of the Canadian system are its federal and bi-cultural character, the dominance of central Canada (only recently beginning to shift westward) and strong economic dependency on the United States. The Canadian brand of federalism gives much of the power over material resources to the provincial governments who, Perks and Robinson argue, display "a pervasive tendency . . . to recapture from local governments certain fundamental powers over use, development and management of land or to expand upon these and the provinces' privileges to structure and influence materially the operation of urban communities". This strong provincial role – considerably stronger than most American states – has advantages but it may be at the expense of national environmental policy-making (difficult at the best of times in Canada) and local innovation. Similarly, in Canada compared with the United States, the courts play far less of a policy-directive and interpretive role; they leave this function to legislative bodies. Canada also lacks much of the openness of the United States' governing process, courts and government information, and public participation. On the other hand the Canadian system of local government is less complex. Canadians share many of the aspirations of their American neighbours but have lesser means of fulfilling them including far less research and development, fewer information resources, and the absence of a well-established "community sector" including large-membership influential environmental groups.

The foregoing substantive-procedural combination, therefore, does produce environmental problems that are uniquely Canadian. While planners may benefit from knowledge and experience derived elsewhere (and vice versa), there are limits to how much Canadian environmental planners can borrow from others. Solutions to environmental problems, in the final analysis, are context-specific.

Principles of Environmental Science

Kenneth Watt has articulated 14 interrelated, core principles of environmental science:

1. All energy entering an organism, population or ecosystem can be accounted for as energy which is stored or leaves. Energy can be transformed from one form to another but it cannot disappear or be destroyed or be created.
2. No energy conversion system is ever completely efficient.
3. Matter, energy, space, time and diversity are all categories of resources. (A resource is anything needed by an organism, population or ecosystem which by its increasing availability, up to an optimal or sufficient level, allows an increasing rate of energy conversion).
4. For all categories of resources, when resource availability is already high, the effect of a unit increase in resource availability often decreases with increasing availability, up to some maximum. Beyond this maximum there is no further beneficial effect. For all categories of resources except time and diversity, further increases beyond the maximum may be harmful because of toxic effects (the saturation or depletion principle). For many phenomena there will be an increased probability of system breakdown as the maximum level of resource availability is reached.
5. There are two fundamentally different types of resources: those whose increasing availability stimulates still further use of them, and those which lack this stimulatory effect. Increasing availability of a resource may stimulate more utilization of that resource.
6. Those individuals and species which have greater numbers of offspring than their competitors tend to replace their competitors.
7. The steady-state diversity of communities is higher in predictable environments (displaying pattern regularity).
8. Whether a habitat becomes saturated with diversity of species in a particular trophic level or taxon (taxonomic group of organisms) depends on how niches (the smallest units of habitat) are separated in the taxon.
9. The diversity of any community is proportional to the biomass (total mass of living organisms in a given area or volume) divided by the productivity. Biological systems evolve in the direction of increased efficiency of energy use, where the physical environment is stable enough to permit the accumulation of diversity.
10. The ratio of biomass to productivity increases through time in a stable physical environment, up to an asymptote.
11. Mature systems exploit immature systems. Energy, matter and diversity flow along a gradient of increasing diversity, or organizational complexity, or from subsystems of lower diversity to subsystems of higher diversity.
12. The perfection of adaptation of any attribute depends on its relative importance in a given environment (which means there is no single best evolutionary strategy; which strategy is best depends on the stability of the physical environment).
13. Physically stable environments allow the accumulation of biological diversity in mature ecosystems, which in turn promotes population stability.
14. The degree of pattern regularity in population fluctuations depends on the number of generations of prior population history which influence the population.

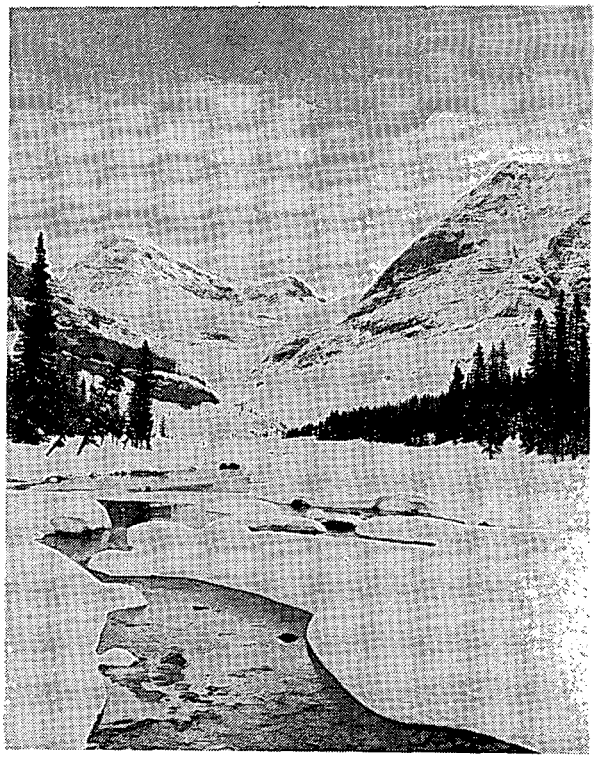
Refer to:
Kenneth E.F. Watt, *Principles of Environmental Science* (New York: McGraw-Hill, 1973), Chapter 2. See Information Resources.

Variety, Complexity and Uncertainty

Uncertainty is a function of variety which in turn is a measure of the number of possible states of a system. A planner's job typically involves: (a) *analysis*, increasing variety in an attempt to gain a better understanding of present and future situations or options; and (b) *synthesis*, chopping down the variety to a few sets of possibilities so that decisions can be reached. The planner's problem in the analysis phase is to be selective in generating the variety, to gather the right information on the right things because uncertainty can result from too much data, as well as too little. By contrast, the problem in the synthesis phase is to reduce the variety without losing the richness of the complex planning situation, that is, to integrate rather than merely simplifying. Ironically, the computer, which has immense capability to help reduce variety in the synthesis phase, is more often used in analysis to create even more variety thereby making the planning more rather than less difficult.

Typical responses to uncertainty are to ignore it, to hide it in assumptions, to wish it away in pie-in-the-sky goal statements, or to suppress it in end-state master plans in the mistaken belief that uncertainty can thus be eliminated. More realistic approaches involve facing uncertainty and attempting to reduce it and minimize its costs. As situations become more uncertain, the planner's predictive ability declines correspondingly, even while the demand for planning increases! The everyday thermostat points to a way out for the planner. Rather than attempting to predict the weather, it regulates the temperature by monitoring it continuously and providing feedback to the heating system which then takes prompt corrective action to eliminate deviations between actual and ideal temperatures. Although the thermostat is a simple model with only limited application, monitoring and feedback (see 5.3 Monitoring) are necessary complements to the planner's predictions in the face of considerable uncertainty. Others include: imposing patterns on information to reduce the overload; mixed scanning (Etzioni); suspending rationality, e.g., accepting a good enough solution instead of looking for the best one; deliberately limiting comprehensiveness by narrowing the scope of the problem; sub-optimizing, "cutting out a piece of the larger problem so that more of it is considered in terms of external influences and less in terms of internal dynamic" (Mack); and making use of techniques such as risk analysis, surprise limits analysis and sensitivity analysis (Hickling).

Hickling suggests that planners and managers typically face three kinds of uncertainty: 1. uncertainty about the operating environment (organizational, cultural, socio-political, economic, physical); 2. uncertainty about policy values, about what is wanted; and 3. uncertainty about choices in related areas of decision, about what others might do. Each kind of uncertainty is matched by ways to reduce it. The first calls for more information and research, the second needs clearer objectives and better policy guidance, and the third requires a broader view and better coordination. A starting point for dealing with (rather than dodging) uncertainty is to differentiate its type in order that the appropriate response may follow.



Case Study 2
Division of Responsibility for Natural Resources in Canada

The legal framework for managing natural resources in Canada is the British North America Act of 1867. A distinction was drawn between the proprietary and legislative rights of government to resources, e.g., between who owns the water and who can legislate its use. In the northern territories the federal government retains complete jurisdiction. Elsewhere, the provinces own the resources. For example, with respect to water, the provinces may permit and license development, regulate flows and levy fees for most uses; the federal government, according to Quinn, can legislate exclusively with regard to navigation and fisheries, concurrently in matters of agriculture and indirectly in regulation of interprovincial and international undertakings including trade.

What the BNA Act could not foresee were the ecologic and economic inter-dependencies that exist today in the management of resources. Because jurisdiction is divided and comprehensive approaches are necessary, coordinated action between and among federal and provincial as well as municipal governments is an essential feature of resource management in Canada. The problems are formidable, not the least of which is to avoid treating resource management as merely a technical planning problem, an administrative problem, or a legal problem.

For a detailed discussion of the legal/administrative framework for environmental planning in Canada, using Ontario as a case in point, see: Mary Anne Carswell and John Swaigen (eds.), *Environment on Trial: A Citizen's Guide to Ontario Environmental Law*, Revised Edition (Canadian Environmental Law Association, One Spadina Crescent, Toronto M5S 2J5), 1978, paperback, 587 pp., $6.95. Also: Ann Rounthwaite, *Pollution and the Law in Canada* (Vancouver: International Self-Counsel Press, 1975), paperback, 86 pp., $2.50.

Information Resources

See also:
1.1 Environmental Issues
1.3 Characteristics of Environmental Planning
2.7 Interrelationships
5.1 Environmental Planning in a Management Framework

Atwood, Margaret. *Survival: A Thematic Guide to Canadian Literature.* Toronto: Anansi, 1972. Paperback, 287 pp. $3.25.

The author asks, "What have been the central preoccupations of Canadian poetry and fiction?". She answers, "Survival and Victims". Chapter 2, "Nature the Monster", discusses images of the natural environment found in Canadian literature. Nature is commonly depicted as dead, or alive but indifferent, or alive and actively hostile towards man. "Death by nature is an event of startling frequency in Canadian literature; in fact it seems to polish off far more people in literature than it does in real life .... The Canadian author's two favourite 'natural' methods for dispatching his victims are drowning and freezing .... Winter for us is the 'real' season". Atwood concludes "Nature is a monster, perhaps, only if you come to it with unreal expectations or fight its conditions rather than accepting them and learning to live with them. Snow isn't necessarily something you die in or hate. You can also make houses with it".

Bella, David A. and Overton, W. Scott, "Environmental Planning and Ecological Possibilities", *Journal of Sanitary Engineering Division* (American Society of Civil Engineers), June 1972.

The authors define a four-part typology of problems depending on the scope and kind of information available: 1. *certain outcome* which lends itself to blueprint-type comprehensive planning and "totally" rational action where we select the alternative whose outcome has the largest payoff; 2. *uncertain outcome, probability specified* which allows much of the uncertainty to be overcome; 3. *uncertain outcome, probability unspecified* where it becomes necessary to resort to decision rules (e.g., maximum); and 4. *unspecified outcome* which in a turbulent world is increasingly common, and where the only response may be to make the receiving environment as adaptable (e.g., ecologically diverse) as possible.

Brown, Lester R. *The Twenty Ninth Day: Accommodating Human Needs and Numbers to the Earth's Resources.* New York: W.W. Norton, 1978. Paperback, 363 pp. $4.55.

The author, president of the Worldwatch Institute, analyzes the four principal biological systems on which mankind depends – fisheries, forest, grasslands and croplands – and shows that demands at current levels of population and per capita consumption often exceed long-term carrying capacity. Over-fishing, deforestation and overgrowing are documented and upcoming energy shortages are examined. The consequences of these ecological stresses and resource scarcities are then assessed, along with the social and political accommodations that will inevitably be required.

Burton, Thomas L. *Natural Resource Policy in Canada: Issues and Perspectives.* Toronto: McClelland and Stewart, 1972. Paperback, 174 pp. $3.50.

Overviews natural resource policy issues in Canada, placing them in a historical, cultural and economic context.

Caldwell, Lynton K. *Environment, A Challenge to Modern Society.* Garden City, NY: Anchor Press/Doubleday, 1971. Paperpack, 301 pp. $3.25.

A social scientist persuasively articulates the need to factor environmental concerns into public policy.

Canadian Environmental Advisory Council. *Annual Review 1976.* The Council (Environment Canada, Ottawa K1A OH3), 1978. 81 pp. Free.

Part B is titled, "The State of the Environment – 1976" (annotated further in 5.3 Monitoring). In the final section, "Synthesis", Ian McTaggart-Cowan, Council Chairman, concludes, 'We are perpetrating a completely unacceptable outrage on the national heritage on which the future of our society depends'.

Cartwright, T.J., "Problems, Solutions and Strategies: A Contribution to the Theory and Practice of Planning", *Journal of the American Institute of Planners*, May 1973, pp. 179-187.

The author suggests that the nature of a problem governs both the range of possible solutions to the problem and the kinds of strategies appropriate for achieving those solutions. Four fundamental types of problems are defined: simple, compound, complex and meta-problem. For each there is a corresponding strategy. The planner's problem is to choose between definitions of problems and strategies for solving them (the closer we get to one objective, the farther we are from the other).

Craik, Kenneth H. and Zube, Ervin H. (eds.). *Perceiving Environmental Quality: Research and Applications.* New York: Plenum Press, 1976. Hardcover, 310 pp. $22.50.

Examines the role environmental perception plays in a proposed comprehensive system of indices for assessing and monitoring trends in environmental quality. Papers cover scenic and recreational environments, residential and institutional environments, and air, water and sonic environments.

Dewees, D.N., Everson, C.K. and Sims, W.A. *Economic Analysis of Environmental Policies.* Toronto: University of Toronto Press, 1975. Paperback, 175 pp. $10.00.

Presents a framework for the economic analysis of pollution problems and for evaluating proposed solutions. Topics include the theory of externalities to explain environmental problems, policy objectives, costs of information and monitoring, and impacts of these costs on selection of pollution control policies. Three case studies cover SO_2 from a smelter, lead from downtown factories, and urban automobile emissions.

Dwivedi, O.P. (ed.) *Protecting the Environment: Issues and Choices – Canadian Perspectives.* Toronto: Copp Clark, 1974. Paperback, 339 pp. $6.95.

Seventeen papers show how governments have responded to environmental problems and what has been done to arrest environmental deterioration, under four headings: nature of the problem, constitutional and legal implications, public policy and governmental processes, and international aspects.

Eckholm, Erik. *Losing Ground: Environmental Stress and World Food Prospects.* New York: W.W. Norton & Co. 1976. Paperpack, 223 pp. $4.35.

A recent FAO global survey of 161 countries reported that the rich are getting fatter while the poor get hungrier. In the rich industrialized countries average daily caloric intake soared to 3 380 while in the 32 poorest countries it has declined to 2 000. The world's undernourished now number 450 million, a figure that is likely to increase. The industrialized nations recorded a steady increase in food production (1.4% a year) while the developing countries experienced a decline (from 0.7% to 0.3% in 1974). Against this background Eckholm examines world food production and its relationship to environmental degradation which undermines food-producing systems.

Etzioni, Amitai. *The Active Society: A Theory of Societal and Political Processes.* New York: Free Press, 1968. Paperback, 698 pp. $7.25.

Annotated in 1.3 Characteristics of Environmental Planning.

Found, William C. *A Theoretical Approach to Rural Land-Use Patterns.* London: Edward Arnold, 1971. Paperback, 190 pp. $3.75.

Chapter 9 is "Perception, Image and Land Use".

Friedenberg, Edgar Z. *The Disposal of Liberty and Other Industrial Wastes.* Garden City, NY: Anchor Press/Doubleday, 1976. Paperback, 196 pp. $3.25.

A controversial book that examines a paradox, "the peculiar incapacity of the democratic, populist national state to deal generously with the less fortunate members of its population". An explanation, the author says, lies in *ressentiment*, the inescapable consequence of exploitation, "a free-floating disposition to visit upon others the bitterness that acccumulates from one's own subordination and existential guilt at allowing oneself to be used by other people for their own purposes while one's own life rusts away unnoticed", the rancor felt towards those who seem to be getting something for nothing. Democratic societies use the concept of "the consent of the governed" to prevent this rancor from upsetting the stability of the state. "The basic flaw in the democratic process is not that the average man is incapable of intelligent participation in the affairs of state. It is that he must be rendered incapable of doing so in order to prevent him from using his formal political powers to challenge the existing distributions of wealth and power".

Goldsmith, Edward, "The Future of an Affluent Society: The Case of Canada", *The Ecologist*, Vol. 7, No. 5, June 1977. Described by: John Marshall, "Plan smaller economy, Ottawa-circulated report says", *Globe and Mail*, 13 Jan. 1978.

A controversial report, commissioned but not released by Environment Canada, based on research carried out in Fall 1975. Goldsmith, who edits this British magazine and was co-author of *A Blueprint for Survival*, argues that Canada's unemployment and inflation problems can never be solved; in fact, chaotic collapse is inevitable unless drastic radical changes are made in the country's social and economic life. He calls for the establishment of a conserver society based on a smaller and different economy, and shows how the industrial system that has benefitted Canadians to this point has done so artificially without bearing the full energy and environmental costs. He foresees de-urbanization, restricted immigration (based on a concern that Canada's food-production capability is smaller and more vulnerable than it appears), life-cycle costing (including the full costs to society in a product's price) and organic farming. Annotated further in 4.1 Agriculture.

Hall, Edward T. *Beyond Culture.* Garden City, NY: Anchor Press/Doubleday, 1977. Paperpack, 298 pp. $3.25.

Hardin, Garrett, "The Tragedy of the Commons", *Science*, Vol. 162, 13 Dec. 1968, pp. 1243-48.

Hardin, Garrett and Baden, John (eds.). *Managing the Commons.* San Francisco: W.H. Freeman, 1977. Paperback, 294 pp. $6.95.

Hickling, Allen. *Aids to Strategic Choice.* University of British Columbia, Centre for Continuing Education (Vancouver V6T 1W5), 1975. Paperback, 64 pp. $4.00.

Annotated in 1.3 Characteristics of Environmental Planning.

Hinkle, Lawrence E. and Loring, William C. *The Effect of the Man-Made Environment on Health and Behavior.* U.S. Dept. of Health, Education and Welfare, Public Health Service, Center for Disease Control (Atlanta, Georgia 30333), 1977. Paperback, 315 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 017-023-00110-8. $3.25 + 25% outside U.S.A.

This book aims at (a) further understanding the means of planned change or preventive action that can be taken in urban residential environments with respect to health and disease or safety and injury, and (b) providing criteria for standards of community hygiene by state and local public health agencies. Ten papers cover various aspects of community health and the urban environment. Unidisciplinary research based on linear cause-effect models has not been able to identify definitively physical factors of man-made environment in human setttlement with health-disease outcomes. Components of man's environment which primarily interact with his physiological organism are inorganic (including climate), biologic, nutrient, man-made physical, and social. The report concludes that a multidisciplinary systems approach is required to mediate. Beyond obvious interventions regarding physical hazards to safety and physical health from poor sanitation or pollution, public health measures must emphasize changes in the physical man-made environment and relevant behaviourial change as well as change in any mediating nutrient and social environment factors.

Krutilla, John V. and Fisher, Anthony C. *The Economics of Natural Environments: Studies in the Valuation of Commodity and Amenity Resources.* Baltimore: Johns Hopkins University Press, 1975. Paperpack, $4.50.

Lang, Jon et al. (eds.). *Designing for Human Behavior.* Stroudsbourg, PA: Dowden, Hutchinson and Ross, 1974. Hardcover, $11.95.

The section, "Fundamental Processes of Environmental Behavior", pages 83-97, provides a useful overview of three sets of psychological processes involved in the everyday interaction of man and environment: perception, cognition and spatial behaviour. Terms are defined, concepts explained, the state-of-the-art outlined; includes an extensive guide to the literature.

Lang, Reg., "Environmental Information in a Planning/Management Context", in Rubec, C.D.A. (ed.). *Application of Ecological (Biophysical) Land Classification in Canada.* ELC Series No. 7, Environment Canada, Lands Directorate (Ottawa K1A OE7), 1978.

Annotated in 5.2 Information.

Leiss, William (ed.). *Ecology vs. Politics in Canada.* Toronto: University of Toronto Press, 1978.

Lynch, Kevin. *The Image of the City.* Cambridge, MA: MIT Press, 1960. Paperback, $3.95.

One of the early books on this subject, now a classic. Deals with how people recall and express their knowledge of previous experience environments. Further annotated in 3.5 Scenic Areas.

Mack, Ruth. *Planning on Uncertainty: Decision Making in Business and Government Administration.* New York: Wiley-Interscience, 1971. Hardcover, 233 pp. $13.90.

Uncertainty is "the complement of knowledge . . . the gap between what is known

and what needs to be known to make correct decisions". The author traces the role of uncertainty in planning and management decisions. Often decision-making processes break down when faced with a set of choices with uncertain consequences. To avoid the risk of failure, decisions are deferred even though that itself is a decision with consequences. Dealing sensibly with uncertainty switches the problem from how to reduce uncertainty to how the costs of uncertainty can be minimized. To choose among these alternative acts one must first determine what states might influence outcomes, then calculate their probability and examine the consequences in terms of the expected utility of choosing each act under each state (noting, however, that this rational model has limited applicability, as Bella and Overton emphasize, above).

Meyer, Phillip A., Phillips, Susan D. and Dodd, J.H. *Local Perceptions Concerning Recreation in the Coquitlam River.* Environment Canada, Fisheries and Marine Service, Habitat Protection Directorate, and B.C. Ministry of Recreation and Conservation, Fish and Wildlife Branch (Parliament Buildings, Victoria, V8V 1X4), April 1976.

This report contains the results of a questionnaire survey exploring attitudes and opinions of residents about a local river within the Greater Vancouver area. In a more general way, it explores the recreational importance of the river to local residents. The results indicate that residents want the river restored to as natural a state as possible. Estimates are provided for recreational benefits of the river and those lost through its degradation over the past two decades.

Miller, George, et al. *Plans and the Structure of Behavior.* New York: Holt, Rinehart and Winston, 1960. Hardcover, 226 pp. $12.95.

In this psychologist's view of planning, a plan is defined as any hierarchical process in the organism that controls the order in which a sequence of operations is to be performed. The book discusses the role of images, plans, instincts (inherited plans) and other such schema in guiding behaviour.

Moore, Gary T. and Golledge, Reginald G. (eds.). *Environmental Knowing: Theories, Research and Methods.* Stroudsburg, PA: Dowden, Hutchinson and Ross, 1976. Hardcover, 441 pp. $25.00.

The field of environmental perception and cognition rests on the assumptions that (a) what we know and believe about different environments affects our actions concerning these environments, and (b) we can better understand people's needs, desires and actions about the environment and can better plan, design and manage the environment and its people if we know how they "image" the world. Environmental cognition, the subject of this book, refers to the awareness, impressions, information, images and beliefs that people have about environments. Part 1 presents theories (information-processing theory, personal construct theory, environmental learning theory and developmental theory). Part 2 introduces three perspectives on environmental cognition – sociological, cross-cultural and literary/phenomenological – with case studies. Part 3 covers a range of methods for exploring the worlds inside peoples' heads.

Passmore, J., "Attitudes to Nature", in Peters, R.S. (ed.). *Nature and Conduct.* New York: Macmillan, 1975. Also, in the same volume: John Benson, "Hog in Sloth, Fox in Stealth: Man and Beast in Moral Thinking".

Annotated in 2.6 Wildlife and Fish.

Prince, George M. *The Practice of Creativity: A Manual for Dynamic Group Problem Solving.* New York: Collier Books, 1972. Paperback, $1.95.

Creativity is a way to deal with uncertainty – making use of both the rational and irrational, in human minds. This practical book tells how to increase the flow of ideas in meetings, the typical setting in which things get done (or not) in organizations. The author analyzes the usual meeting ("a study in frustration"), discusses new structures and roles, presents a theory of creative thought (based on "synectics"), puts forward techniques (e.g., use of analogy, directed originality, the synectics process) and examines the uses of creativity for individuals and organizations.

Quinn, Frank, "Notes for a National Water Policy", in Krueger, Ralph R. and Mitchell, Bruce (eds.). *Managing Canada's Renewable Resources.* Toronto: Methuen, 1977. Paperback, 333 pp. $9.95.

Saarinen, Thomas F. *Environmental Planning: Perception and Behavior.* Boston: Houghton Mifflin Co., 1976. Paperback, 262 pp. $7.25.

Beginning on a personal level and expanding to architectural space (buildings and groups of buildings), neighbourhoods and small towns, then cities, regions, nations and the planet, the author examines issues of perception and behaviour in planning the environment for human beings. Man's relationship to progressively larger units of his environment is analyzed, research results are reported, and integrating frameworks are discussed.

Schumacher, E.F. *Small is Beautiful: A Study of Economics as if People Mattered.* New York: Harper and Row, 1975. Paperback, $2.95.

In the four years since its publication this book has become a classic that examines the economic structure of the Western world in a new way. The late Dr. Schumacher maintains that man's pursuit of profit and progress, which promotes giant organizations and increased specialization, has resulted in gross economic efficiency, environmental pollution and inhumane working conditions. He proposes instead a system of intermediate technology based on smaller working units, communal ownership and regional work places using local labour and resources and emphasizing the person, not the product.

Sudia, Theodore W. *The River in the City.* U.S. Dept. of the Interior (Washington, DC 20240), n.d. 21 pp. Free.

A pamphlet in the Department's "Urban Ecosystem" series.

Swaigen, John, "Polluter-pays policy called mere puffery", *Globe and Mail,* 7 Aug. 1978, p. 7.

The author, general counsel for the Canadian Environmental Law Association, attacks the polluter-must-pay policy, enunciated but not practiced by various governments in Canada. Swaigen argues, "No group of victims of widespread pollution in this country has ever successfully sued a large corporation for their losses". Barriers cited to effective environmental protection include unenforceable laws, the delaying tactics available to wealthy corporate defendants, the high costs of lawyers and scientists to make a case against corporations or governments (and the ominous threat of possibly having to pay their costs), lack of availability of government scientific reports, restrictions on class actions, taken on behalf of a group of citizens, onerous proof requirements, lack of "standing" (the requirement that a plaintiff show substantial damage beyond the harm to the general public), and the timidity of judges and their narrow interpretation of the statutes.

Tribe, Lawrence H. et al. (eds.). *When Values Conflict: Essays on Environmental Analysis, Discourse and Decisions.* Philadelphia: Ballinger, 1976. Hardcover, $15.00.

This useful book comprises a series of essays by an engineer, a physicist, a philosopher, a sociologist and two economists who address problems of values within the environmental and institutional context. Special attention is given to the relationship between man and his natural surroundings. The essays analyze how values have been dealt with in environmental decisions and suggest ways they might have been handled with greater sensitivity.

Tuan, Yi-Fu. *Topophilia: A Study of Environmental Perception, Attitudes and Values.* Englewood Cliffs, NJ: Prentice-Hall, 1974. Paperback, 260 pp. $5.25.

A study of man's perceptions, cognition and behaviour as it relates to his sense of place.

Watt, Kenneth E.F. *Principles of Environmental Science.* New York: McGraw-Hill, 1973. Hardcover, 319 pp. $15.50.

A basic useful text with chapters on background material from biology and mathematics, 14 principles of environmental science, fundamental ecological variables (matter, energy, space, time and diversity), mechanisms of selfregulation in ecological systems, perturbation in ecological systems by weather, man, fossil fuels and the perturbation and degradation of ecological systems, the lake, a typical exploitable ecosystem, the forest as a study in determinants of ecosystem structure and dynamics, the watershed, an example of

multiple use and conflicting demands, grass land and range systems as examples of reciprocal interactions between plants and animals, agricultural systems and the problem of replacing optimizing strategies of nature by optimizing strategies of man, biological control, the reestablishment of a tolerable steady state, the environment and infectious disease, a special class of biological regulating systems, urban, regional and national planning in the light of ecological principles, and a global strategy for mankind.

Whyte, Anne. *Guidelines for Field Studies in Environmental Perception.* Renouf Publishing Co. (2182 St. Catherine St. W., Montreal H3H 1M7), 1977. $7.95.

Acknowledgements 1.3

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1.3 Characteristics of Environmental Planning

Planning means organized preparation for purposeful action. It is a basic everyday human activity, a way of thinking and getting ready to act. Planning involves analyzing a situation, working out what is desired, exploring and evaluating options, and devising a course of action. At the more complex scale of public planning, various interests initiate actions and are affected by other actions; such planning, therefore, necessarily involves conflict and compromise.

Planning, pervasive in the managing of organizations, takes various forms: budgetary planning, economic planning, land use planning, health services planning, corporate planning and so on. "Environmental" planning can be viewed either as bringing a particular set of concerns to these kinds of planning or as a form of planning which addresses relationships among activities, environments and effects. Some environmental planners work for agencies whose mandate is defined around certain *environments* – habitat, a watershed, the Great Lakes, a neighbourhood, etc. Others are primarily oriented to *activities*, such as transportation; they attempt to increase the degree of environmental consideration entering decisions affecting environments. Still others find themselves interested first and foremost in *effects* – preventing, minimizing and mitigating adverse effects of activities on environments.

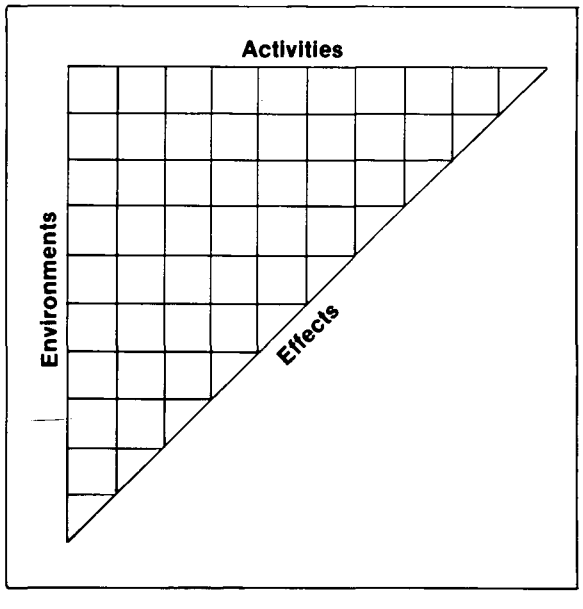


Figure 1.5 Central Concerns in Environmental Planning

Substantive Characteristics of Environmental Planning. The field of environmental planning, in an early stage of development, deserves a broad definition. Here, environmental planning means *preparing for purposeful action directed towards specific environments or environmental resources for the overall purpose of optimal enhancement of environmental capacity and quality.*

Optimal enhancement. Enhancement encompasses conservation, preservation, protection, improvement, creation, restoration. These words are not synonymous; their inclusion merely signals the range of concerns of environmental planners. "Optimal" is added to imply long-term net gain from resources consistent with selected levels of input (rather than ever-higher levels of input).

Capacity. Natural environments have limits beyond which human activity will lead to undesirable changes in environmental functioning, loss of valuable work done for man, or loss of quality. These limits can be expressed as *supportive capacity*, that is, the ability to supply resources and energy for certain activities, (aggregate for construction and Class 1 soil for agriculture are two examples) and *assimilative capacity*, or the ability to handle wastes from human activities.

Quality. Air pollution standards, for example, are intended to protect quality of air in terms of human health, property, vegetation and amenity. Though sometimes quantified, measures of quality are based on human perception. Qualities may exist without man but man's judgments define quality, giving it a strong subjective dimension. Quality judgments are both individual and collective, the latter forming the basis for environmental planning.

Capacity and quality are closely related. In natural environments, carrying capacity limits population size; organisms die off when such capacity is exceeded. In human environments, however, the more likely consequence is an altered environment of reduced quality. Capacity definitions in environmental planning oriented to human activity, therefore, include quality considerations and vice versa. Recreational carrying capacity, for example, refers to the level of recreation use beyond which environmental change is considered unacceptable; when the recreation resource is sufficiently degraded, so is the recreational experience and the user's satisfaction. Note that capacity and quality, while related intrinsically to the environment and the perceptions of men experiencing environments, are also tied to deliberate *management* decisions. A recreation agency determining what facilities to provide in a park makes a management decision to set the level of quality of desired recreational experience, within constraints imposed by environmental capacities.

The capacity/quality relationship raises special problems for the environmental planner. Capacity and quality are often incompatible because they cannot be maximized simultaneously. Instead, one of the two is maximized subject to constraints. Example: maximizing the quality of a lake for one use (perhaps recreational) by constraining its capacity (e.g., limiting sewage discharges and increasing effluent standards), versus maximizing lake capacity for various uses (including sewage disposal) by constraining its quality (perhaps zoning out certain uses such as swimming). An alternate solution is to maximize a combination of capacity and quality objectives.

Other substantive characteristics of environmental planning (expressed as principles by Dorney, Cooper and Vlasin, Mattyasovszky, Holling and Goldberg, Odum and others) reflect key characteristics of environmental issues and problems:

Biosphere/ecosystem perspective: a concept of man in nature, rather than separate from it, including dynamic interaction of human-activity systems and natural systems in ecosystems and ultimately in the biosphere. Other kinds of planning tend to be more narrowly focused.

Systemic: focusing on wholes and their related parts, on key components and their relationships; working with open systems which interact with their environments; recognizing the connections and dependencies among systems.

Site-specific but scale-elastic. The word "environment" underscores the uniqueness of each place; simultaneously, it is necessary to relate environments and environmental change to larger contexts, and vice versa.

Time-conscious: considering environmental change over various time cycles, long and short, past and future. Other kinds of planning have shorter time horizons.

Impact-oriented: demonstrating the environmental effects of human activities and revealing how these effects are distributed (who benefits, who pays). Other kinds of planning are more input-oriented, focusing more on data, goals and plans than on effects.

Fundamentally preventive: not merely reactive. Prominent in the repertoire of environmental planning strategies is "demand conservation" which focuses on reducing the demand for particular goods and services whose provision creates undue environmental stress, rather than accepting demand as a given and attempting only to minimize adverse impacts.

Procedural Characteristics of Environmental Planning. Planning processes typically proceed from ends to means (no matter how many feedback loops are shown on idealized flow charts). Goals, either given to the planners or formulated by them, commence a planning-making exercise. The current condition is analyzed. Needs are identified, usually on the basis of projected economic and population growth. Forecasts are made of the unconstrained future (what would likely happen if no additional interventions occurred). Alternate means are devised for achieving the goals, given past and projected conditions. Alternatives are evaluated using criteria derived from the goals and the planner's judgement. Choices are made and a recommended plan is worked out for presentation to clients, publics and other makers and influencers of decisions.

Such ends-to-means planning, however, is seldom appropriate for environmental problems, considering their special characteristics (Section 1.2). Where environmental systems and cause-effect relationships are poorly understood, and/or where the means to achieve environmental goals are not clear at the start, environmental effects of alternate actions cannot be predicted with reasonable accuracy. Predictive planning then must give way to more exploratory probing accompanied by careful monitoring, feedback and corrective response. Similarly, where numerous interests are involved in executing the plan or are affected by its implementation, and/or where environmental values are poorly defined (due largely to people's lack of awareness of their dependencies on their environments and of the ways valued environments are degraded), it becomes extremely difficult to define goals as Step 1 in the planning process. Instead, planning becomes a back-and-forth learning

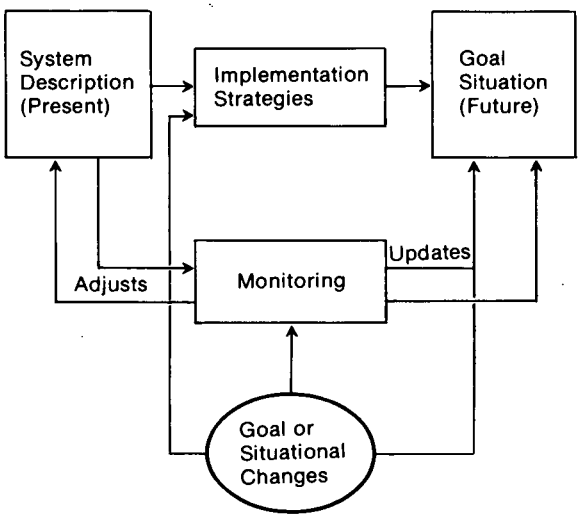


Figure 1.6 A Generalized Planning Process

Source: Peter W. House, *The Quest for Completeness: Comprehensive Analysis in Environmental Management and Planning* (Toronto: Lexington Books, D.C. Heath, 1976). Reprinted with permission.

process with attainable ends and feasible means emerging together. The likelihood of arriving at a plan which is more or less acceptable to all the effecting and affected interests is slim when the ends-to-means approach is used. Planners seldom possess the power to compel consensus.

An alternative planning approach, more congruent with environmental problems and the settings within which they occur, has these characteristics:

Recursive. As an environmental planning exercise proceeds the planners can expect to go back and repeat any or all of the steps in response to new inputs. Goals in particular will evolve from vague to sufficiently specific to guide action, often in the form of policies.

Evaluative and participative. Environmental planning is needed because environmental resources are undervalued. A large part of this is due to poor information on and understanding of environmental systems. Goals that reflect popular preferences would be unlikely to give environmental capacity and quality sufficient priority. Part of the environmental planner's role is to raise the level of popular and political awareness concerning the relationships between individual/collective actions and the things people *do* value, and the capacity/quality of affected environments. This learning process will be assisted if (a) matters of fact are separated as much as possible from matters of value, and (b) as environmental awareness and support grow,

planners widen the consulative process, reevaluate the acceptability of environmental objectives and proposed measures, and attempt to resolve the conflicts that inevitably arise.

Coordinative. Environmental problems tend to cut across jurisdictions and interests, public and private. Since the planner and his client agency are limited in the extent to which they can force comprehensive environmental action on the other parties involved, it becomes necessary to work out acceptable arrangements among them. This is less a matter of convincing others of the rightness of the environmental plan than of making it in their interest to change. Incentives are required (if you'll do this for us, we'll do that for you) as well as disincentives (such as publicly disclosing the results of monitoring environmental changes including who caused them). An integrated approach is less likely to be achieved by the planners preparing and presenting a comprehensive *plan* than through a gradual *process* of planning that includes carrot-stick persuasion, negotiation among interests and continual coordination (including what Friend calls the "reticulist" function of connecting environmentally related activities of various actors). This "linked-incrementalism" approach gradually accumulates an integrated set of actions within a comprehensive framework of environmental policies.

Multi-dimensional. Coming at any environmental issue from a number of directions at once is necessary because (a) numerous autonomous actors and often-conflicting interests are typically part of complex environmental issues, (b) environmental concerns are typically low in public priority and support for them has to be built up, and (c) a single solution to a complex environmental problem is usually successfully opposed in legal and administrative processes. Multi-dimensional also means making sure that the client, a municipal council or a corporate board of directors for example, perceives that those responsible for the implementing action are in favour of the plan and that those interests affected by it support it.

Multi/interdisciplinary. The many facets of a typical environmental issue necessitate contributions to environmental planning from a range of disciplines. This is much easier said than done, however. It is one thing to assemble a team comprising different backgrounds where each contributes on the basis of his or her expertise (multidisciplinary). It is quite another to expect team members to transcend their disciplines and pool their knowledge and skills in plan preparation (interdisciplinary). Serious problems are commonly experienced within such teams (Bella and Williamson, Alonso); disciplinary conflicts, often rooted in differing professional values, get in the way. The final inter-disciplinary work more often than not occurs when the person in charge disappears for a week and returns with the report written. The multidisciplinary alternative risks a watered-down value-neutral uncreative outcome that fails to come to grips with basic issues. Solutions to interdisciplinary problems do exist (see Greenall) but their application is still infrequent.

We trained hard. But it seemed that every time we were beginning to form up in teams, we would be reorganized. I was to learn that later in life we tend to meet any new situation by reorganizing. And a wonderful method it can be for creating the illusion of progress while producing confusion, inefficiency and demoralization.
Petronius Arbiter, 66 A.D.

Combining the foregoing substantive and procedural characteristics results in a form of planning that, while resembling other forms, also differs from them. The differences lie not so much in the methods used as in the form the planning process takes and the strategy, emphasis, timing and style employed by the environmental planner.

Environmental Planning Principles

R.S. Dorney, Professor of Planning at the University of Waterloo and a consulting ecologist, has articulated a set of "philosophical and technical principles for identifying environmental planning and management strategies". Based on an "ethical triad for ecology" (reverence for life, land and diversity), the principles are organized around three themes: planning, natural science and social science. The following is a condensed list (see also Information Resources).

Planning

- Develop site-specific environmental goals and objectives, related to government policies at various levels, to guide planning, assist evaluation and facilitate communication.
- Favour low-risk designs. Build flexibility and reversibility into land use, infrastructure and resource-use decisions.
- Understand compatibility/incompatibility between adjacent land uses.
- Undertake environmental protection planning including mitigation, risk assessment, contingency plans and monitoring. Work environmental protection measures into construction processes.

- Identify and create/enhance amenity landscape resources.
- Incorporate environmental policies and protection measures into official plans.
- Assess environmental impacts of new projects.
- Evaluate new technology from a natural resource, cultural and economic perspective.
- Identify institutional structures and their capability, and work to change or reinforce them where appropriate.

Natural Science

- Systematically inventory existing resources; identify natural processes or functions for land units and their present/potential value to man.
- Understand historical ecosystem properties and trends; predict thresholds, lags, feedbacks and limits to the ecosystem; identify significant transboundary ecosystem linkages.
- Determine ecosystem stability-resiliency-diversity relationships.
- Understand population dynamics of key organisms; identify organisms which may indicate environmental quality.
- Determine carrying and assimilative capacity limits.
- Understand land capability/feasibility; map biological productivity; identify relationships between size of land unit and biotic resources.
- Identify: constraints or hazardous areas; areas serving a landscape protection function; areas offering opportunities for renovation, enhancement, linkage or sequential use of land; and unique geological and biological land units or sensitive areas.
- Identify health and nuisance related landscape problems.
- Identify and control existing and new externalities on as small a land unit as possible.
- Plan for conservation and sustained yield of resources.
- Regulate or reduce entropy in ecosystems.
- Design low maintenance landscape systems.
- Design for and promote monitoring of ecosystems.

Social Science

- Identify community and institutional values, concerns and perceptions. Identify specific natural features of symbolic importance.
- Understand cultural linkages between land uses, productivity and resource recycling or re-use.
- Map recreational capability.
- Evaluate local/regional economic strategies within the context of environmental concerns.
- Develop strategies to alter human values and perceptions, where feasible.
- Develop educational approaches at all levels.

Source: R.S. Dorney, *Philosophical and Technical Principles for Identifying Environmental Planning and Management Strategies*, paper presented to Canadian Arctic Resources Committee Seminar, Edmonton (Ecoplans Ltd., 544 Conestogo Road West, Waterloo, Ont. N2L 4E2), February 1978, 21 pp.

Planners, Politicians, Producers and Publics

Benveniste argues convincingly that the planner, especially the environmental planner, tends to be oriented primarily to the elected decision-maker in a modern version of Machiavelli's pundit whispering in the ear of the Prince. This narrow orientation is at the expense of linkages with publics (the beneficiaries or victims of plans) and producers (the implementing agencies, often regarded as the planner's competitors for the politician's attention). Dominance of the planner-politician relationship is based on three shaky assumptions:

1. That the politicians represent the public and therefore consulting the former makes it unnecessary to consult the latter. Reality: politicians represent us on only a limited range of things, they respond to some interests a lot more than others, and the elected-elector linkage is often quite tenuous.
2. That the politicians control the implementing agencies – the various departments responsible for constructing facilities, delivering services and regulating private actions – and that a plan or policy approved

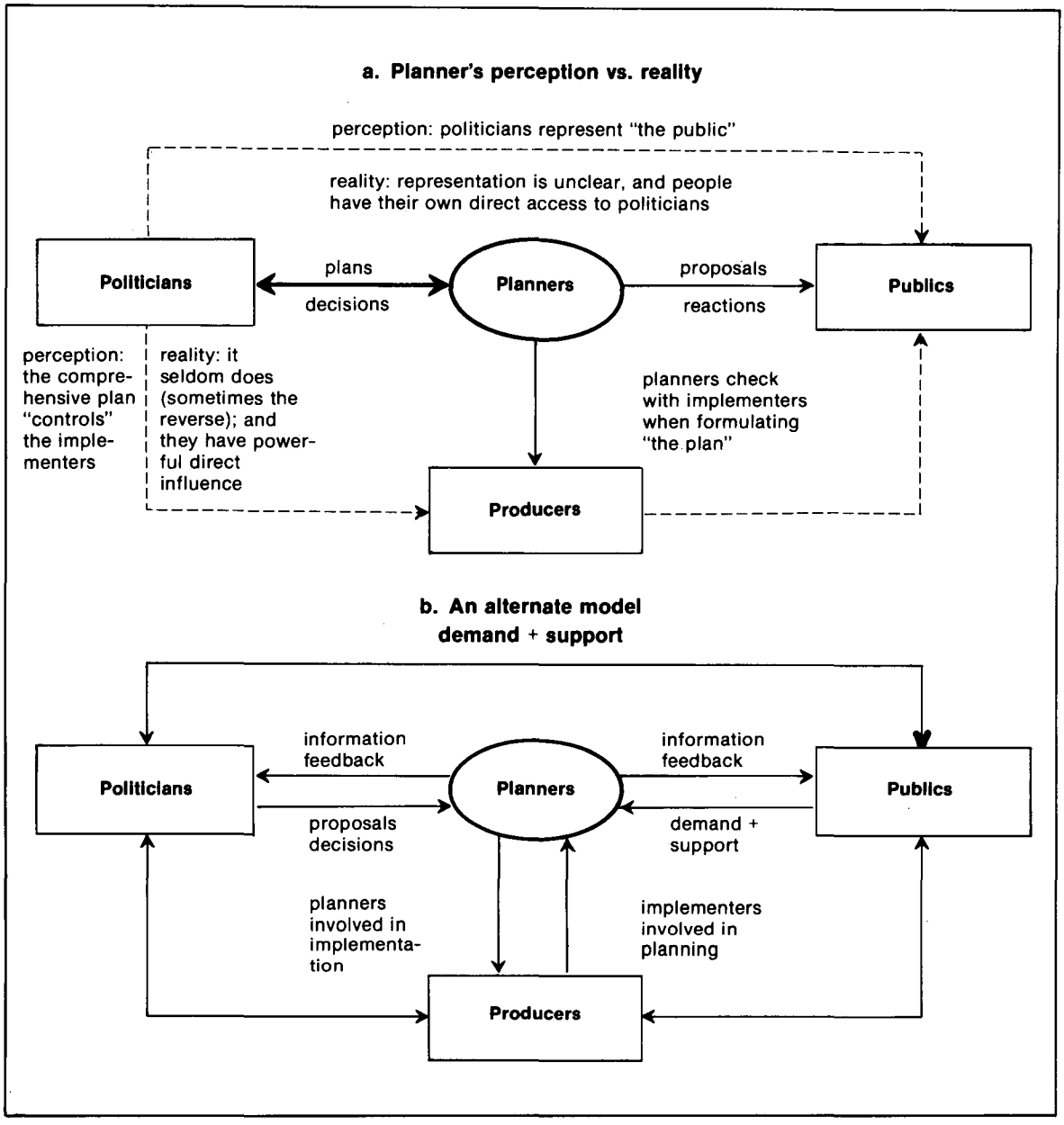


Figure 1.7 Planners, Politicians, Producers and Publics

by the politicians therefore will require these "producers" to fall in line and conform to it. Reality: it is not easy for a municipal council, or even a federal/provincial cabinet, to exercise total control over their departments, especially where these are large. Some of them, responsible for services with popular appeal and/or policial sensitivity, have their own independent power bases.

3. That sound arguments alone, will persuade elected representatives to adopt comprehensive plans. Reality: politicians respond more to immediate issues, specific interests, perceived demand and support. They are concerned more for the short run and use techniques tending to the intuitive based on experience, judgement and a sense of timing. Planners are more oriented to "the public interest", longer-range system balance and scientific methods.

The approach demanded by environmental issues develops relationships with publics, producers *and* politicians – the former two preceding the latter, to increase the likelihood of political commitment to environmental plans and programs – as indicated in Fig. 1.7. Environmental planning is similarly multi-dimensional *inside* organizations (this point is elaborated in Section 5.1).

Refer to:
Guy Benveniste, *The Politics of Expertise*, Second Edition (San Francisco: Boyd & Fraser, 1977). Annotated in Information Resources, this section; see also Catanese, and Lash.

Case Study 3
Environmental Conservation in Canada's Past

Lest we forget, Canada experienced a surge of environmental interest and activity 60 to 90 years ago when the conservation movement, emerged in North America as a response to careless over-exploitation of natural resources. Unlike today, however, the conservationists of that period sought to re-mould the landscape into a more productive economic unit. Conservation was viewed as a dynamic process redirecting resource development toward efficient and wise use.

Under federal legislation the Commission of Conservation was established in 1909, with Clifford Sifton as Chairman, as an advisory body charged with gathering information on the natural resources of Canada and advancing a policy for their development. During its dozen years of operation the Commission: established committees to examine land, water-power, fishery, game and fur, forest and mineral resources as well as public health; laid the groundwork for resource management across the country; imported Thomas Adams whose work launched the town planning profession and Produced Planning Acts in most of the provinces; helped mediate federal-provincial conflicts; began an inventory of Canada's natural resources (still not complete); and disseminated information on a wide range of topics. The Commission even proposed a national energy plan! In 1921, for reasons never clearly established (but suspiciously political, in the worst sense of that word), the Commission was terminated.

See: Smith, C. Ray and Witty, R. David, "Conservation, Resources and Environment, An Exposition and Critical Evaluation of the Commission of Conservation, Canada", *Plan* (Canadian Institute of Planners, then the Town Planning Institute of Canada), Vol. 11, No. 1, December 1970, pp. 55-7; and "Conservation, Resources and Environment, The Commission of Conservation, Canada, Part 2", *Plan*, Vol. 11, No. 3, May 1972, pp. 199-216.

Information Resources

See also:
1.1 Environmental Issues
1.2 Characteristics of Environmental Problems
5.1 Environmental Planning in a Management Framework
5.4 Plans

Alonso, William, "Beyond the Interdisciplinary Approach to Planning", *Journal of the American Institute of Planners*, May 1971, pp. 169-173.

Appleyard, Donald. *Environmental Planning and Social Science: Strategies for Environmental Decision-Making*. University of California, Institute of Urban and Regional Development (Berkeley, CA 94720), Working Paper No. 217, 1973. 37 pp.

Concerned with the proliferation of social science research and how it may be used by professional planners and designers, this paper explores some strategies that might be considered to incorporate socio-environmental concerns in daily decision-making. Emphasis is placed on citizen participation, comprehensive environmental evaluation of projects prior to committment, and environmental management which emphasizes the long-term monitoring of environments. A "socio-environmental model for planning and design" is presented consisting of a five-part system of people, their activities, needs and values, perceptions and environments.

Bella, David A. and Williamson, K.J., "Conflicts in Inter-Disciplinary Research", *Journal of Environmental Systems*, Vol. 6, No. 2, 1976-77, pp. 105-123.

Benveniste, Guy. *The Politics of Expertise*. Berkeley, C.A.: Glendessary Press, 1972. Paperback, 232 pp. Second Edition, Boyd and Fraser, 1977. Paperback, $5.95.

An intriguing book for practicing planners/bureaucrats and the politicians who hire them. Takes a fresh look (from a Machiavellian perspective) at the planner/politician relationship (the Prince and the Pundit) and particularly at the political nature of expertise and its use. The master/servant role is exposed and much subtler sources of power for the planner are revealed. An example: the multiplier effect (a plan or policy, even when not implemented, may be influential if the various decision-makers and affected implementers believe it will be and reorient their actions to what they believe will happen). Equally, Benveniste discusses the ways in which planners can be manipulated and explains why many plans fail.

Caldwell, Lynton K., "The Ecosystem as a Criterion for Public Policy", *Natural Resources Journal*, Vol. 10, No. 2, April 1970, pp. 203-221.

Catanese, Anthony James. *Planners and Local Politics: Impossible Dreams*. San Francisco: Sage Publications, 1974. Paperback, $6.00.

A witty treatment of planners and politicians — the proposers and the disposers-with good insights into the relationship and the basic differences between the two. The author concludes, "If planning is to be successful as measured by the quality of policies, plans and programs developed and actions resulting from such efforts, then planners will have to adapt to more politicized roles because all of these activities occur within a political process. The essence of the politicized role for the planner is such that he must reject the traditional self-justification as the savant of the community responsible for its total future and more properly view himself as the *manager of change*".

Coleman, Alice. *Canadian Settlement and Environmental Planning*. Ministry of State for Urban Affairs (Information Resource Service, Ottawa K1A OP6), 1977. Paperback, 70 pp. Free.

"Environmental planning is planning oriented towards survival. It conserves resources and displays a strong element of cautious insurance, over and above providing for contingencies that can already be foreseen from the restricted viewpoint of today. It acknowledges a duty to future unborn generations as well as to the needs of the present, and it aims to promote healthy environments that will be capable of self-sustained continuity and stable adaptation, in place of unstable dislocation." The author (a British academic) offers an approach to environmental planning based on a framework of land use patterns organized within five environmental territories: wildscape, farmscape, towscape, marginal fringe and urban fringe (waterscape is included as a sixth territory). Characteristics and problems of each "scape" are examined, with implications for environmental planning.

Coleman, Derek J. *An Ecological Input to Regional Planning*. University of Waterloo, School of Urban and Regional Planning (Waterloo, Ont. N2L 3G1), 1975. Paperback, 227 pp.

Annotated in 5.2, Information.

Cooper, William E. and Vlasen, Raymond D., "Ecological Concepts and Applications to Planning", in McAllister, Donald M. (ed.). *Environment: A New Focus for Land Use Planning*. Washington, D.C.: National Science Foundation, 1973. Paperback, 328 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Catalogue No. N51.2: ENB, $3.75 + 25% outside U.S.A.

Dansereau, Pierre. *Harmony and Disorder in the Canadian Environment*. Canadian Environmental Advisory Council (Environment Canada, Publications Distribution Centre, Ottawa K1A OH3), 1975. Paperback, 146 pp. Free.

Based on (a) a concept of decision-making in which the initial impetus is social (rather than, as now, political), the planning is primarily eco-technical (not economic-technical) and the impacts are economic and political (instead of social and ecological), and (b) an ethic that says "every man shall strive to maintain harmony within and between all the ecosystems upon which he has influence, thereby ensuring the continuance of diversity and the availability of choice, and also minimizing irreversible changes". Chapters expand on: ecology, environment and management; the requirements of environmental planning; the forces of environmental control; points of crisis in Canada (in wild, rural, industrial and urban areas); and priorities, based on austerity, science, planning, information and consultation.

Dorney, R.S. *Philosophical and Technical Principles for Identifying Environmental Planning and Management Strategies*. Ecoplans Ltd. (544 Conestogo Road West, Waterloo, Ont. N2L 4E2), 1978. 21 pp.

Paper presented to Canadian Arctic Resources Committee Seminar, Edmonton, Feb. 1978. The author articulates his concept of enivronmental management based on an "ethical triad": Leopold's land ethic, Schweitzer's reverence for life, and a new "ethic of diversities". He elaborates a set of 41 technical principles to guide the professional practice of environmental management and discusses their application in the form of case studies.

Dorney, R.S. and Rich, S.G., "Urban Design in the Context of Achieving Environmental Quality Through Ecosystems Analysis", *Contact* (University of Waterloo), May 1976, pp. 28-48.

Institutional and legal procedures are being put in place in many industrial countries so that environmental quality issues related to development may receive more comprehensive attention. Environmental scientists will be asked increasingly to help "quantify issues of urban environmental quality in a more holistic way, generally using a systems analysis approach". This paper traces the evolution of four approaches or levels of urban design commonly encountered in North American cities: *flat earth planning*, in which man imposes his activities upon an assumed flat featureless plain; *contour planning*, where the topographic map introduces the shape of the earth but little else; *constraint planning*, which requires designers to identify landscape features and integrate them into the plan or consider them as constraints to which the design must be sensitive; and *ecosystem planning*, a multidisciplinary approach which includes three major interrelated subsystems (cultural/historical, abiotic and biotic) and the inputs that urban design and construction would have on them. Each level of planning is examined in detail, applied to a 455-acre rural area, and compared to the other levels along a range of measures (historical continuity, safety and health amenity, energy consumption, erosion, water quality, etc.) expressed as a 16-question check-list for examining subdivision proposals.

Dunn, Edgar S., Jr. *Economic and Social Development: A Process of Social Learning*. Baltimore: Johns Hopkins Press, 1971. Hardcover, 327 pp. $11.50. Annotated in 2.7 Natural Systems and Processes.

Edington, John M. and M. Ann. *Ecology and Environmental Planning.* London, England: Chapman & Hall, 1971. Hardcover, 246 pp. £8.50.

"Environmental planning" is defined here as an attempt to balance and harmonize the various enterprises which man, for his own benefit, has superimposed on the natural environment. The book discusses ecology's potential contribution to environmental planning; it summarizes the relevant ecological information and demonstrates the practical application of ecological principles and methods. The first part of the book surveys ecological implications of various rural land uses, urban and industrial development, transport systems and man-made lakes. The second part, using four case studies, shows how a planning strategy for an entire region can be analyzed comprehensively in ecological terms.

Elgin, D.S. et al. *Alternative Futures for Environmental Policy Planning: 1975-2000.* Washington, DC: U.S. Environmental Protection Agency, Office of Pesticide Programs, Strategic Studies Unit, EPA-540/9-75-027, 1975. Paperback, 286 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402).

Explores a range of alternative futures covering the last 25 years of the century, concentrating on the U.S. but in a world context. The methods include trend analysis (focusing on climate, energy, food production, values and social trends), skeletal scenarios (energy, climate, food and social values were selected as the "driving" trends to which the future was considered particularly sensitive), survey of futures literature (brief summaries of underlying assumptions of the future, from key sources) and scenario expansion. The 10 alternate futures that resulted were reduced to three main themes: industrial success, industrial failure and industrial transformation. Policy conclusions suggested a more environmentally conscious society in the longer run (1985-95), the likelihood of numerous policy reversals demanding flexible planning, and substantial social change coming up.

Etzioni, Amitai. *The Active Society: A Theory of Societal and Political Processes.* New York: Free Press, 1968. Paperback, 698 pp. $7.25.

Chapter 12, "Mixed Scanning: An Active Approach to Decision-Making", explores an approach that seeks to combine the advantages while avoiding the short-comings of comprehensive planning and disjointed incrementalism. A mixed-scanning strategy differentiates fundamental (contextuating) decisions from bit (ordinary day-to-day) decisions. The former are made through an exploration of the main issues and alternatives in view of overall goals but unlike the comprehensive approach, details are omitted so that overviews are possible. The latter are made incrementally but, unlike disjointed incrementalism, they occur within the context set by the mixed-scanning stategy. Such a strategy, thus, conforms more closely to reality (similar to what we do when writing a major report by beginning with an outline, proceeding to write, then returning to alter the outline when we get stuck). Guidelines for application are discussed.

Fairbrother, Nan. *New Lives, New Landscapes: Planning for the 21st Century.* New York: Alfred Knopf, 1970. Hardcover, 397 pp.

FitzPatrick, Malcolm S. *Environmental Health Planning: Community Development Based on Environmental and Health Precepts.* Cambridge, MA: Ballinger Publishing Co., 1978. Hardcover, 265 pp. $19.00.

Environmental health planning, for the author, involves the application of interrelated information derived from using the "ecological model, the historical precedence of public health, and the analytical process of urban planning; ecology presents a model of interaction and equilibrium, public health provides a rationale, and urban planning offers a decision-making process". The book sets out a comprehensive planning framework for application to environmental health problems.

Friedmann, John, "The Future of Comprehensive Planning: A Critique", *Public Administration Review*, Vol. 31, No. 3, 1971, pp. 315-326. See also Friedmann, *Retracking America: A Theory of Transactive Planning* (Doubleday, 1973).

Friend, J.K., Power, J.M. and Yewlett, C.J.L. *Public Planning: The Inter-Corporate Dimension.* London: Tavistock Publications, 1974. Hardcover, 534 pp. $21.95.

A difficult but rewarding book whose central message is that the public sector, dealing with issues whose resolution is often interorganizational, needs but cannot rely solely on corporate planning drawn from the private sector. Organizing clearly formulated objectives into a hierachical framework and methodically pursuing them is tempting to public planners, and municipalities *are* corporate entities. But comprehensive planning in large public agencies inevitably depends on the outcomes of other public and private agencies, as well as on many subtle relationships among organizational units. Demands for grassroots participation add to the uncertainty. The authors propose bringing an inter-corporate dimension to public planning in the urban and regional sphere. Drawing on extensive experience of the Institute for Operational Research in British local government, they outline the field of policy concern, consider issues confronted by an expanding urban centre (redevelopment, transportation, housing, industry, environmental, improvement) and develop a series of general propositions about planning in complex organizational environments (the inescapability of inter-agency processes, the strategies people adopt in response to complexity, the influence on decisions of the interactive learning that occurs, the inevitability of adopting a selective approach to forming and using decision networks, the dependence of this approach on the exercise of local judgement when problems don't follow foreseeable patterns, and the need for "reticulist" or linking/networking skills as critical to multi-interest planning). Application of the principles is discussed at length. See also Hickling, below.

Friend, John, Hickling, Allen et al. *The Environmental Sciences in Regional and Structure Planning.* London: Tavistock Institute of Human Relations, 1976. *Vol. I: Main Report*, 85 pp. *Vol. II: A Guide for Planners and Scientists*, 79 pp. *Vol. III: Background Papers. Vol. IV: A Supplementary Report* (restricted), 38 pp. Available from Institute for Operational Research (4 Copthall House Station Square, Coventry CV1 2PP, England). £6.00 the set.

Documents a research project that explored the effects of improved information about the natural environment on different strategic planning policies. Volume II (to environmental planners, the most significant of the four) is a useful guide for planners and environmental scientists concerning how the latter may play a stronger role in planning processes especially at local and regional scales. It is organized in five parts: 1. definitions of the environment, the environmental sciences, strategic planning (which emphasizes but is not confined to physical planning and the management of land), the planner/scientist interface, the management of uncertainty, and the "interpreter" role (necessary to render scientific information relevant to planning); 2. the environmental sciences, including purpose (why scientists do what they do), process (how they go about it) and product (environmental information); 3. regional and structure planning, explaining purpose, process and product, this time for the planner; 4. increasing the role of the environmental sciences in strategic planning (organizing the work, collecting and analysing information, studying alternative strategies, designing and choosing policies, and the continuous planning process); and 5. recommendations. Although prepared in the British context, the guide is written at a level of abstraction that makes its insights, principles and approaches relevant to the Canadian scene.

Giliomee, J.H. "Ecological Planning: Method and Evaluation", *Landscape Planning*, Vol. 4, 1977, pp. 185-191.

Describes the ecological planning method devised by Ian McHarg. The basic premise is that for any living system there is a survival value in finding the fittest environment (that environment where the largest part of the work required for the survival of the system is done by the environment) which it can adapt and adapt to. The system that will be healthy, thriving and survive in the long term is the one located in and maintaining a fit environment. The planner's function is to direct development in order to achieve the best fit. This requires a sound understanding of the environment and its users or proposed users, and the capability of predicting the

consequences of contemplated events in the biophysical realm in which action is going to occur. The steps in the planning process are outlined.

Greenall, J.W. "Integrating the Work of Multi-Disciplinary Assessment Teams", in Plewes, M. and Whitney, J.B.R. (eds.). *Environmental Impact Assessment in Canada: Processes and Approaches.* University of Toronto, Institute for Environmental Studies (Toronto M5S 1A4), 1977. Paperback, $5.00.

Hare, Richard. "Contrasting Methods of Environmental Planning", in Peters, R.S. (ed.). *Nature and Conduct.* London: Macmillan, 1975.

A discussion of the application of ethical theory to planning. The two methods contrasted are the means-end model, where collective values expressed at the start of the planning exercise form the basis for evaluation of alternate plans, and the author's preferred trial-design model where ends and means interact as the planner presents his proposals for evaluation and thereby learns about collective values.

Hickling, Allen. *Aids to Strategic Choice.* University of British Columbia, Centre for Continuing Education (Vancouver V6T 1W5), 1975. Paperback, 64 pp. $4.00.

A useful, clear statement that summarizes work of the Tavistock Institute on the application of operations research to planning and management. Hickling discusses the process of strategic choice, the analysis of interconnected decision areas, management of variety and complexity, discrimination between alternative solutions, management of uncertainty, and the commitment package (in place of the end-state master plan). See the insert, "Variety, Complexity and Uncertainty", in 1.2 Characteristics of Environmental Problems.

Hills, G. Angus, Love, David V. and Lacate, Douglas S. *Developing a Better Environment: Ecological Land-Use Planning in Ontario. A Study of Methodology in the Development of Regional Plans.* Toronto: Ontario Economic Council, 1970. Paperback, 182 pp. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $3.00, cheque payable to Treasurer of Ontario.

Annotated in 2.4 Soil/Soil Capability.

Holling, C.S. and Goldberg, M.A. "Ecology and Planning", *Journal of the American Institute of Planners,* Vol. 37, No. 4, July 1971, pp. 221-230.

House, Peter. *The Quest for Completeness: Comprehensive Analysis in Environmental Management and Planning.* Toronto: Lexington Books, D.C. Heath and Co., 1976. Hardcover, 245 pp. $15.00.

Summarizes a series of research projects, carried out by or through the U.S. Environmental Protection Agency, focusing on comprehensive long-range analysis in planning and management of the environment. Several strategies of comprehensive analysis are examined: comprehensive planning (under the National Environmental Policy Act, at the municipal level, linked to residuals management, utilizing carrying capacity, etc.), environmental management (NEPA, various organizational structures at the state level, for guiding urbanization toward environmental objectives related to land use planning and decisions, strategy examples), comprehensive modelling with examples, and the use of environmental indicators, especially quality-of-life. Annotated further in 2.7 Natural Systems and Resources.

Isard, Walter. *Ecologic-Economic Analysis for Regional Development.* New York: Free Press, 1972. Hardcover, $15.95.

Kaiser, E.J. et al. *Promoting Environmental Quality Through Urban Planning and Controls.* Washington, DC: U.S. Environmental Protection Agency, 1974. Paperback, 441 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $4.25 + 25% outside U.S.A.

Surveyed approximately 200 local and metropolitan planning approaches to an urban land use guidance system. Other chapters cover water resource management, urban design and residuals (air, water) management.

Kelcey, John. "Planning and Ecology in a New Town", *The Planner* (Royal Town Planning Institute), Vol. 62, No. 2, Feb. 1976, pp. 45-47. See also Kelcey, *Ecology and Development: Ecological Studies in Milton Keynes,* Milton Keynes Development Corporation (Wavendon Tower, Wavendon, Milton Keynes MK17 BLX, England).

Lang, Reg and Armour, Audrey. *Municipal Planning and the Natural Environment.* Toronto: Ontario Planning Act Review Committee, 1977. Paperback, 90 pp. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $1.25, cheque payable to Treasurer of Ontario.

Detailed study of natural environment component in Ontario official plans, with proposed framework for environmental management and recommended changes to the Planning Act. Elaborated, through a case study approach, in Thomas Melymuk and William Hughes, *Natural Environments in Ontario Municipal Planning: Progress and Prospects,* for Ontario Ministry of the Environment, Nov. 1976; annotated in 5.4 Plans.

Lash, Harry. *Planning in a Human Way.* Ministry of State for Urban Affairs (Information Resource Service, Ottawa K1A OP6), 1976. Paperback, 96 pp. Free.

Annotated in 5.8 Public Participation.

Lassey, William R. *Planning in Rural Environments.* New York: McGraw-Hill, 1977. Hardcover, 257 pp. $17.95.

Written by a rural sociologist, this book: introduces rural planning and its special characteristics; presents a set of key issues as the rationale for rural planning (urbanization of land and society, industrialization of agriculture, problems of rural communities, natural resource depletion, etc.); discusses the planning function at local and regional scales in terms of existing practice and changing concepts of land-use planning; examines planning for human services in rural regions; deals with implementation and planning as well as with the organization and operation of rural planning programs; offers case studies of rural planning practice in the Netherlands and the United Kingdom; illustrates problems of rural planning with a case study of a major recreational development (the Gallatin Canyon project in Montana – see Information Resources, 4.6 Recreation); considers the education of planners and public education for planning; and closes with an organizational model for planning in rural regions.

Leopold, Aldo. *A Sand County Almanac.* New York: Ballantine, 1977 (originally published 1949). Paperback, $1.95.

Marsh, William M. *Environmental Analysis for Land Use and Site Planning.* New York: McGraw-Hill, 1978. Hardcover, 292 pp. $22.50.

Chapters cover spatial organization of the environment, slope and topography, soils and drainage, vegetation, floods and floodplains, sources and acquisition of environmental information, applications of environmental analysis, communication of environmental information and special topics (landslide hazard mapping, remote sensing and impact assessment).

Mattayasovszky, E. "Key Principles in Planning for Environmental Quality", *Plan Canada,* Vol. 15, No. 1, 1975, pp. 38-43.

McHarg, Ian. *Design with Nature.* Garden City, NY: Doubleday/Natural History Press, 1969 and 1971. Paperback, 197 pp. $6.95.

Classic in the environmental planning field, heavily influential on practice. See also Giliomee. Examples of application appear in 5.4 Plans.

Meshenberg, Michael J. (ed.). *Environmental Planning: A Guide to Information Sources.* Detroit: Gale Research Co., 1976. Hardcover, $18.00.

Munn R.E. (ed.). *Environmental Impact Assessment: Principles and Procedures.* SCOPE 5 Report, Toronto, 1975. Paperback, 160 pp. Available from Dr. T.F. Malone (Holcombe Research Institute, Butler University, Box 192, Indianapolis, Ind. 46208), $10.25.

An environmental planning sequence is presented in Chapter 2. Annotated further in 5.5 Environmental Impact Assessement.

National Association of Home Builders. *Cost Effective Site Planning.* NAHB (15th and M St. NW, Washington, DC 20005), 1976. $12.50.

Environmental and energy considerations receive some coverage.

Odum, Eugene P.,"The Strategy of Ecosystem Development", *Science* 164, 18 April 1969, pp. 262-270.

Ohio Dept. of Natural Resources, Division of Planning. *A New Approach to Land Use Planning in Ohio.* The Division (1952 Belcher Drive, Fountain Square, Columbus, Ohio 43224), 1977. 22 pp.

Presents an environmentally oriented municipal planning approach. Based on the suitability-capability of the land to accommodate human activity, it involves the relationship of man and nature on the premise that nature varies from plabe to place. The recommended approach allows the environment, properly understood, to guide planning.

Paget, Gary. *Towards a Theory for Environmental Planning.* York University, Faculty of Environmental Studies (4700 Keele St., Downsview, Ont. M3J 2R2), 1976. Paperback, 84 pp. $1.00.

M.E.S. major paper. Develops a normative theory to guide the practice of a kind of planning oriented to natural/human environments ("environment" refers to the totality of external and internal forces and factors to which an organism or group of organisms is actually or potentially responsive). Discusses the need for and nature of planning theory, the rationale for planning from an ecological and social ethic perspective, the dimensions of environmental planning, and applications in Canada.

Perks, William T., and Robinson, Ira M. (eds.). *Urban and Regional Planning in the Federal State: The Canadian Experience.* Stroudsburg, PA: Dowden, Hutchinson and Ross, forthcoming Oct. 1978.

This collection of essays responds to a perceived need to fashion "a Canadian repertoire in the fields of planning, urbanism and environmental management" and to make available a major document on planning topics firmly rooted in the Canadian experience. Papers and case studies are organized in five parts: organization, regionalism and public policies; resources, natural ecology and the environment; land ownership, control and management; organization for planning and development; and public participation.

Porteous, J. Douglas. *Environment and Behavior: Planning and Everyday Urban Life.* Reading, MA: Addison-Wesley, 1977. Hardcover, 446 pp. $13.75.

Text on man-environment relations covering (from macro to micro scales) the urban environment (human, physical, personal, contextual) and urban planning with emphasis on behavioural and participative aspects.

Rutgers University, Institute for Environmental Studies. *A Guide to the Environmental Aspects of the Local Planning Process.* N.J. Dept. of Community Affairs, Bureau of Local Management Services, Local Planning Assistance Unit (363 W. State St., Trenton, N.J. 08625), 1976. Paperback, 196 pp. $3.00.

A manual to guide the practice of environmental planning at the local level in New Jersey. Part One briefly discusses environmental issues under three headings: natural resource inventory, municipal land use law and environmental regulations, and environmental impact statement. Part Two, comprising most of the volume, sets out what natural resource information is needed and why under nine headings: hydrology; water supply; groundwater; surface water; water quality; geology and soils; erosion and sedimentation management; use of soil for waste disposal; vegetation and wildlife; open space preservation; and unique and historic site preservation. Part Three tells how to prepare and implement a natural resource inventory approach.

Sargent, Frederic O. *Rural Environmental Planning.* American Society of Planning Officials (1313 East 60th St., Chicago IL 60637), 1976. Paperback, 199 pp. $7.00.

Presents a planning method, developed and extensively tested in the rural Vermont context, "designed to be environmentally compatible, politically acceptable, financially feasible, socially equitable and supportive of rural public goals". A rural environmental plan is "a comprehensive plan for a rural town or municipality based on environmental planning concepts and focused on protection of the natural environment, providing access to the natural environment, and providing whatever additional facilities and controls the voters want". It "recommends uses for all land with reference to the carrying capacity of the land, the need for conservation and the goals of the people". Growth and environmental quality are not seen as necessarily incompatible. "REP is based on an assumption that if the quality of the environment is maintained, then land values will increase, and the greatest economic (most profitable) use of the land may be developed as well as the best environmental and social use". The planning process, envisioned as complementary to rather than in place of conventional planning (more emphasis to REP in smaller and rural areas, more on conventional urban planning in larger centres), follows a special procedure for formulating public goals in an open planning process which includes an educational effort to convince voters that such goals are attainable. Emphasis is given to aesthetics, natural area protection, wildlife habitat protection, conservation zoning (identifying and zoning areas which should not be disturbed or built upon in order to protect water quality and prevent stream erosion), provision for extensive recreation facilities, providing public access to public waters, protecting agricultural land, improving water quality, and controlling the rate of growth. The book covers organizing for REP, discovering public goals, preparing inventory and classifying the natural resource base (with the emphasis cited above), the social impact of rural planning (particularly significant in rural areas), economic and legal aspects, and evaluation of the planning process.

Science Council of Canada. *Canada as a Conserver Society: Resource Uncertainties and the Need for New Technologies.* Ottawa: Supply and Services Canada (Printing and Publishing, Ottawa K1A OS9), 1977. Paperback, 108 pp. $2.25.

The Council's statement on the kind of society deemed necessary for Canada, providing the environmental planner with an alternate future (as near as 10 years) to consider. Outlines why such a society is needed, its principal policy thrust and some areas for application.

Simonds, John O. *Earthscape: A Manual of Environmental Planning.* New York: McGraw-Hill, 1978. Hardcover, 340 pp. $24.95.

Well-illustrated large-format book containing practical tips for environmentally oriented planners along with case studies under these headings: the earth, air, water, the visible landscape, noise, paths of movement, the planned community, urbanization, regional planning, dynamic conservation, and a search for quality.

Stearns, Forrest W. and Montag, Tom (eds.). *The Urban Ecosystem: A Holistic Approach.* Stroudsburg, PA: Dowden, Hutchinson and Ross, 1974. Hardcover, 217 pp. $18.00.

Examines the concept of the urban ecosystem and its application in practice. See also J. Linville and R. Davis, *The Political Environment: An Ecosystem Approach to Urban Management,* American Institute of Planners (1776 Massachusetts Ave., NW, Washington, DC 20036), 1976, paperback, 151 pp., $7.00, which includes several case studies of environmental management.

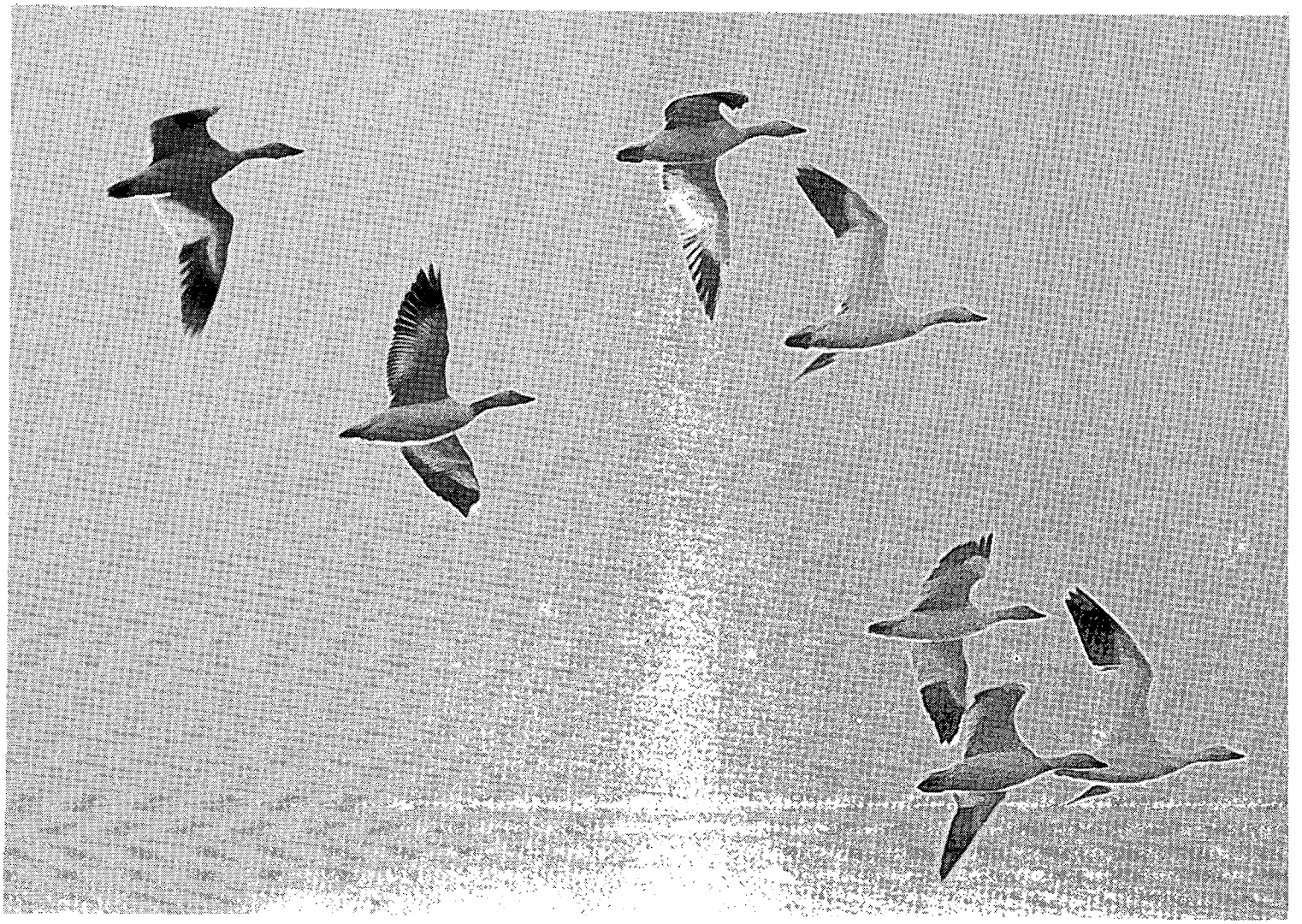
Wickersham, Kirk et al. *A Land Use Decision Methodology for Environmental Control.* U.S. Environmental Protection Agency (Office of Research and Development, Washington, DC 20460), EPA-600/5-75-008, 1975. Paperback, 18 pp. Available from National Technical Information Service (5285 Port Royal Road, Springfield, Va. 22161).

Proposes an "environmentally responsible land use decision-making system", based on valid ecological information combined with enlightened and informed public opinion, for local, regional and state governments. Concepts used include policy planning, the interdisciplinary team, public participation, the environmental resource inventory (dealt with, in terms of approach and method, in a 22-page appendix), staff capability, legal controls, and positive community programs.

Wiken, E.B., "Ecologically Based Planning: A Report on the CCELC Urban Workshop", in Rubec, C.P.A. (ed.). *Application of Ecological (Biophysical) Land Classification in Canada.* Ecol. Land Class. Series No. 7, Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1978. Free.

Chapter 2

2. Environmental Resources



2.1 Land

In everyday language a resource is something that is available for our use when we need it. More specifically, "resource" represents a functional relationship between what man needs or wants, his biophysical environment which acts as provider, and his ability to transform the environment to meet his needs. The definition of resource, therefore, is biological, physical and cultural; and it encompasses both opportunities and constraints. O'Riordan (Information Resources, Section 5.1) sums it up by concluding: "A resource is an attribute of the environment appraised by man to be of value over time within constraints imposed by his social, political, economic and institutional framework".

Resources by themselves or collective aggregations of them can be of value. For instance, a particular soil type may be considered an agricultural resource whereas a certain area of land because of its combined attributes of water, vegetation, climate and landforms may be appraised as valuable recreation resource. With this in mind, this chapter is organized under the heading of *land* and subsequently its component parts, *air, water, soils and landforms, flora* and *fauna*. There is also a concluding section dealing with the relationships among natural systems, human activities and institutional arrangements. Each section examines briefly the nature of that particular resource, its value to man, the constraints it imposes on human activity, the consequences of ignoring these constraints (pollution, for example), and opportunities through environmental planning and management to achieve a more harmonious equilibrium between man and nature.

"Land" has various meanings. To some people it is the platform for human activity, to others merely two-dimensional space. In Canada land is a commodity, a form of investment, property to be acquired and sold preferably at a profit, a bundle of rights to pass on to one's heirs. Some, however, regard land more as a resource for exploitation or preservation, or as landscape, encompassing a natural arrangement of related components and processes. Taken in its broadest sense, land encompasses the people, their settlements and culture, and the biological and physical setting, all together – with deeply rooted emotional overtones ("our home and native land").

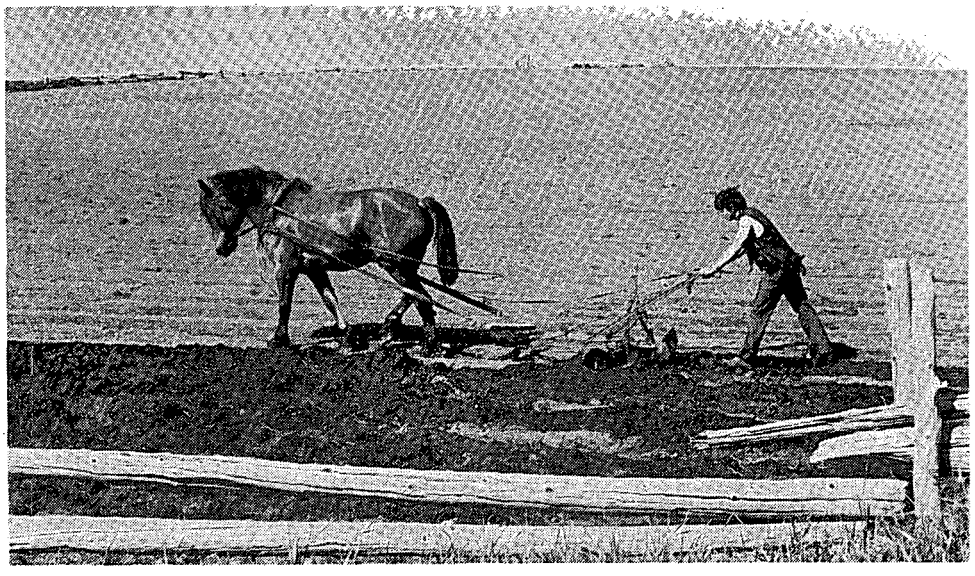
The Soil Conservation Society of America offers this definition of land:

> *The total natural and cultural environment within which production takes place; a broader term than soil. In addition to soil, its attributes include other physical conditions such as mineral deposits, climate, and water supply; location in relation to centers of commerce, populations, and other land; the size of the individual tracts or holdings; and existing plant cover, works or improvement, and the like. Some use the term loosely in other senses: as defined above but without the economic or cultural criteria; especially in the expression "natural land", as a synonym for "soil", for the solid surface of the earth; and also for earthy surface formations, especially in the geomorphological expression "land form".*

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The diversity of meanings attached to land reflects the various functions land fulfils, as well as changing perceptions of what the key purposes of this unique resource ought to be. While land is finite, that is, its productivity can be increased only to a point, it will not be a depletable resource if properly used. Improper use, on the other hand, wastes the land resource and may cause it to be lost forever.

Man's use of the land seldom affects only one resource. It is more typical that several resources will be affected simultaneously. A large housing development on a particular tract of land, for example, could mean: tying up valuable gravel resources which lie below the ground surface; destroying a significant wildlife habitat; removing native plant cover which has some unique value; or disrupting a natural recharge zone for subsurface waters. These multiple resource impacts which commonly emerge in the planning proposal stage are the primary reasons why environmental planning should be based on land taken in its broadest sense.

Land Capability

Land capability refers to the ability of the land to accommodate a particular use or activity without permanent damage. Determination of capability involves interpreting climatic, vegetation, soil and other data in terms of limitations for use and recognizing the role of technology and money in overcoming limitations.

Capability, therefore, relates both to the characteristics of the land and those of the activity or use in mind. The Canada Land Inventory (Fig. 2.1), carried out over the past 15 years by the federal government in cooperation with the provinces, provides capability for four sectors: agriculture, forestry, outdoor recreation and wildlife. In each classification category, units of land are mapped and grouped into one of seven classes (with sub-classes); Class 1 has the highest capability, Class 7 the lowest. Maps largely at a scale of 1:250 000 and in colour cover the settled portion of Canada and are readily available ($1.00 each from Supply and Services Canada). More detailed coverage in larger-scale black and white maps are also available from most provinces.

Table 2.1 Canada Land Inventory, Soil Classification for Agriculture

Class	Limitations for Agricultural Use
1	No significant limitations
2	Moderate limitations that restrict range of crops or require special conservation measures
3	Moderately severe limitations that restrict range of crops or require special conservation measures
4	Severe limitations that restrict range of crops, require special conservation practices, or both
5	Very severe limitations that restrict capability to produce perennial forage crops; improvement practices are feasible
6	Capable only of producing perennial forage crops; improvement practices not feasible
7	No capability for arable agriculture or permanent pasture

Table 2.1 summarizes the land capability classifications for agriculture; similar classifications and maps exist for forestry, outdoor recreation and wildlife (ungulates and waterfowl). Classes 1 to 4 are considered capable of sustained use for cultivated field crops; in its "Food Land Guidelines" the Province of Ontario considers all lands where soil classes 1, 2, 3 and 4 predominate to be high-capability agricultural land.

Classes 5 and 6 are good only for perennial forage crops. Class 7 has no capability for agriculture. Note, however, that the relationship of productivity is not direct, as Table 2.2 shows. The yield for Class 4 land is only half that of Class 1, i.e., it takes more than twice the acreage of the former to make up for a given lost acreage of the latter (Hoffman).

Table 2.2 Performance Indices of Soil Classes

Class	Common Field Crops	Forage
1	1.00	1.00
2	.80	.80
3	.64	.66
4	.49	.58
5	No value	.53
6	No value	.44
7	No value	No value

Several limitations of the CLI need to be borne in mind by environmental planners. First, the CLI does not necessarily indicate the best use or the profitability of that use. The classification, for example, does not take account of location, access, distance to markets, size of units, ownership or present state. Second, the maps show capability irrespective of present use; an area of prime agricultural land could now be forested. Third, the CLI rating system is national in scope. Consequently, for local planning the relative differences which exist between ratings may be more important than the variations across the country. For example, a class 3 unit, if it is the best parcel of land locally, will be more significant to the local planner than a class 1 unit in the next province. Fourth, because the CLI program was done on a provincial basis, some variations in rating may occur. This means that Class 1 in some cases may not exactly correspond to Class 1 in another province. Fifth, not all areas within the CLI coverage were mapped, even though many contain areas of high capability. The exclusions include urbanized areas, some national and provincial parks, military reserves and Indian reserves. Finally, because of the reconnaissance nature of the CLI program, land areas were not mapped and described for detailed levels of planning; the program was intended for regional planning purposes. Having a general overview perspective, the CLI classification system rates the dominant capability of any parcel of land and overlooks small inclusions which may be of significance at more detailed levels of planning. It

Initial mapping was normally done on aerial photographs transferred to manuscripts at 1:50 000 or 1:63 360. S and U distinguish between shoreland and upland units; they do not indicate subclasses.



The published map is in colour. This beach would be rated Class 1 except that it is moderately exposed and the water is very cold. It is rated 3S*PBQ for cultural landscape pattern, beach activities and topographic diversity.

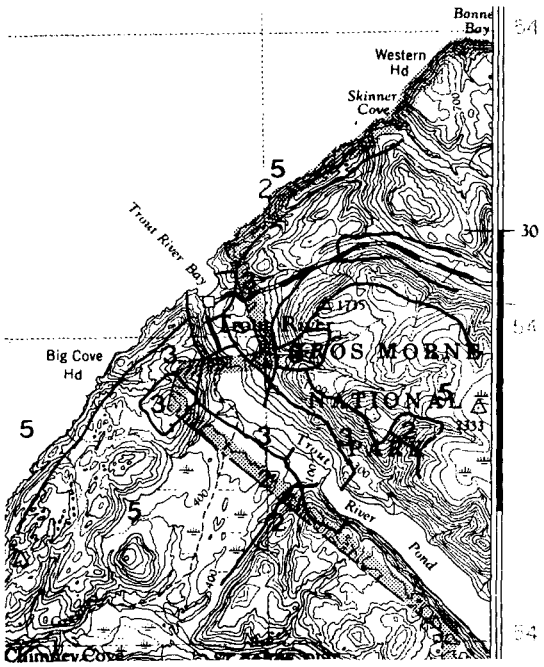


Figure 2.1 An Example of a Canada Land Inventory Map: The Beach at Trout Bay, Newfoundland

Source: M.C. Taylor, *The Canada Land Inventory. Land Capability for Recreation. Summary Report* (Ottawa: Environment Canada, Lands Directorate, Oct. 1978)

should also be noted that CLI maps may require updating especially in areas where the landscape has been altered since the survey was completed.

Generally, CLI maps are useful to identify prime and marginal land, to plan resource activity at the larger scale, to help avoid conflicts between potential resource use and other uses such as urban development, and to make the case for protecting the valuable land resource (the straightforward CLI maps are useful aids in communicating with non-technical people). On the other hand, CLI maps – and this also applies to the usual soil capability maps, unfortunately – are at scales too small for detailed land use/or environmental planning. Careful "ground truthing" is required for more detailed levels of planning.

Other, more specific and (for the environmental planner) more useful soil survey information often exists at the provincial or regional/local level. The British Columbia example is documented here. Another, the Ontario Soil Survey, rates soils along certain measures (slope, internal drainage, depth to bedrock, boulder content, susceptibility to flooding) deemed to be important for "urban and suburban" use (specifically homesite location, road and underground utility construction, septic tank operation, gravel extraction) as well as for waste disposal. Similarly, a Land Capability and Constraints Map helps planners, policy formulators, decision-makers and administrators organize land-based information, and discover intrinsic suitability and limitations of a region or other area for certain resource exploitation and land development.

CLI land capability maps fail to communicate the dynamic quality of natural processes interacting with each other and with human activities on the land. The landscape approach to land classification attempts to overcome this lack of holistic perspective by focusing on ecosystems rather than on specific attributes of the land or selected and scape components. The "total site" is considered, embracing biophysical (both biotic and abiotic) components within landscape units.

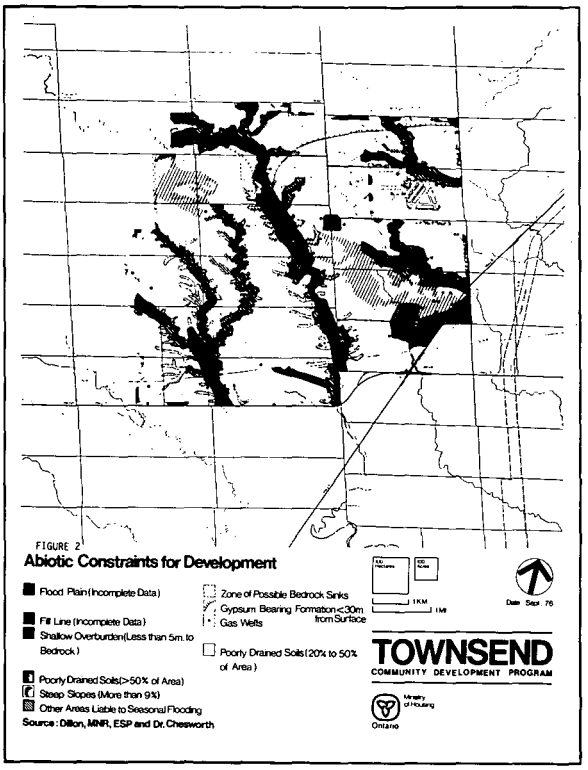


Figure 2.2 Example of a Land Capability and Constraints Map: Townsend New Community, Ontario.

Source: R.S. Dorney, "Biophysical and Cultural-Historic Land Classification and Mapping for Canadian Urban and Urbanizing Land", in E.B. Wiken and G.R. Ironside (eds.), *Ecological (Biophysical) Land Classification in Urban Areas. Proceedings of a Workshop, Canada Committee on Ecological (Biophysical) Land Classification, 23& 24 November 1976, Toronto Ontario* (Ottawa: Environment Canada, 1977). Taken from: Llewelyn-Davies weeks Ltd et al., *Phase I Report: Townsend Community Development Program* (Toronto: Ontario Ministry of Housing, 1976).

Work on an integrated approach to land classification has been evolving in Canada recently through the activities of the Canada Committee on Ecological (Biophysical) Land Classification, building on work begun by the National Committee on Forest Land in 1964. Areas of land are being classified according to their ecological unity. The classification process includes the description, comparison and synthesis of data related to the biological and physical characteristics of the land, using the five levels shown by Figure 2.3. Since the publication of guidelines in 1969, some 60 projects have been completed or begun, covering over a million square kilometres (Figure 2.4).

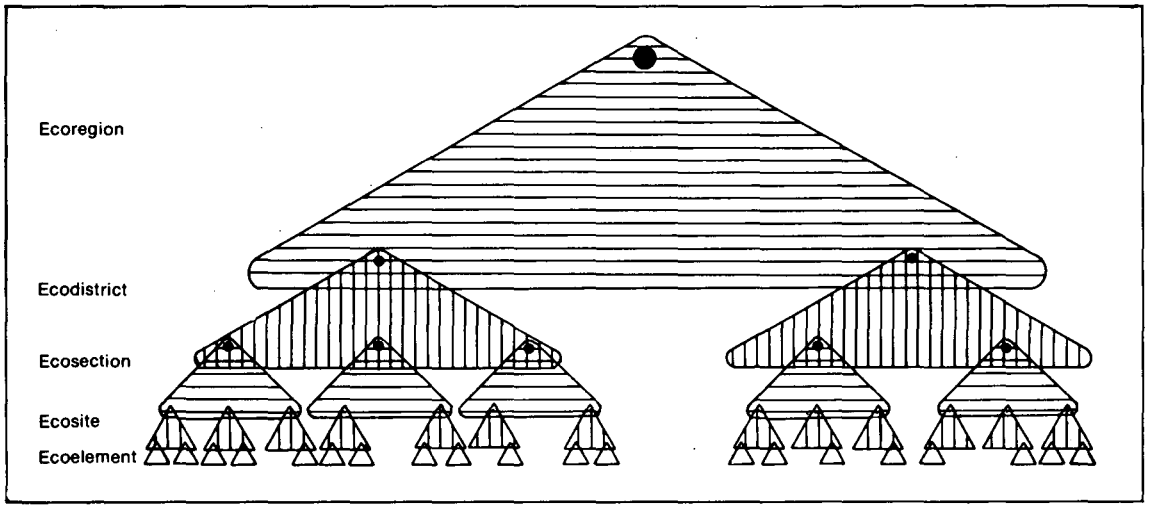
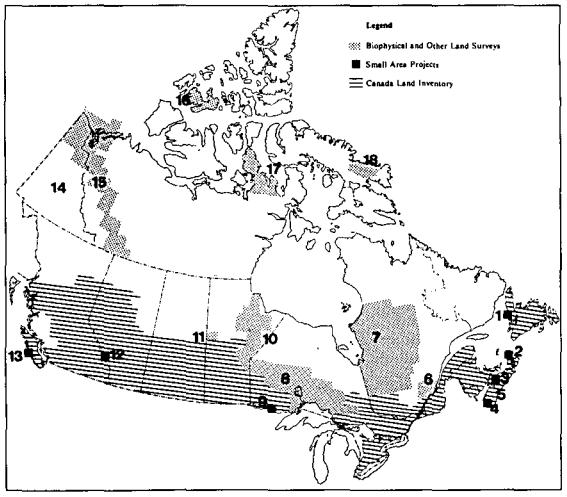


Figure 2.3 Levels of Ecological Land Classification

Source: Environment Canada, Lands Directorate



1. Gros Morne
2. Miscellaneous, N.S.
3. Cumberland and Colchester
4. Tobeatic
5. Kejimkujik
6. Saguenay-Lac St. Jean
7. James Bay
8. Northwest Ontario
9. Experimental Lakes
10. Northern Manitoba
11. Cormorant Lake
12. Banff/Jasper
13. Pacific Rim
14. Yukon (ecoregions only)
15. Mackenzie Valley
16. Melville Island
17. Boothia Peninsula
18. Auyuittuq

Figure 2.4 Projects of the Canada Committee on Ecological Land Classification

Source: Canada Committee on Ecological (Bio-physical) Land Classification, *Newsletter*, No. 2, 1977.

Case Study 4
Urban Land Suitability, B.C.

Submitted by Bo Martin, B.C. Ministry of Municipal Affairs and Housing

Over the past three to four years the Resource Analysis Branch of the B.C. Department of the Environment has devised a system of "Urban Suitability Mapping". Physical characteristics (soil, landforms, topography, water table, permeability, flooding, etc.) are correlated with various urban uses such as dwellings with/without basements, septic fields and heavy structures.

Contact:
Mark Walmsley
Resource Analysis Branch
Ministry of the Environment
Parliament Buildings
Victoria, B.C. V8V 1X4
(604) 387-5281

Case Study 5
Soil Suitability for Septic Disposal Fields

Submitted by Michael Simmons, Maritime Resource Management Service, and Julia Davidson, N.S. Dept. of Municipal Affairs

Numerous septic tank failures in Nova Scotia are attributed to improper design, installation and maintenance, and to unsuitability of the soil. This study by J.L. Nowland of the Soil Research Institute, Ottawa, and M.D. Simmons, Maritime Resource Management Service) maps

areas with soils which would not meet current public health regulations. Such regulations involve percolation rate (in most of rural Nova Scotia, the "perc test" is the only development control measure in use), depth to water table and depth to bedrock.

The investigators discovered two other important factors: period of soil saturation and excessively rapid percolation in sands and gravels. Each of the province's 120 soils was assessed using these parameters. Field measurements were conducted on marginal soils and numerous public health test results were plotted on soil maps and correlated with the soils. Eleven categories were eventually devised. Each was assessed with a percent probability of occurrence and depicted on a map of Nova Scotia at 1:450 000 ("Soils of Nova Scotia, Limitations for Septic Tanks Absorption Fields", Soil Research Institute, Canada Dept. of Agriculture, Ottawa 1976). The map also lists all soils recognized in Nova Scotia with the appropriate category. From this list county surveys can be used, at scales up to 1:63 360, to indicate soil limitations for absorption fields.

Field tests of the resulting maps by public health inspectors have indicated considerable success, and some required modification. The maps, however, are not a substitute for on-site testing, and their usefulness is limited by the accuracy of the original soil maps. But classification of all soils does allow the local planner, health inspector and land developer to make a preliminary comparison of various sites before proceeding to detailed developing.

Copies of the maps are available from: Information Centre, Maritime Resource Management Service, P.O. Box 310, Amherst, N.S., at $1.50 each.

Contact:
Michael D. Simmons
Maritime Resource Management Service
Box 2254
Halifax, N.S.
(902) 424-5899

See also: N.S. Dept. of Municipal Affairs, Community Planning Division, Annapolis Valley Region, *Natural Environment Suitability for Residential Development*, Dec. 1976. This report integrates information on soil suitability for septic tanks (based on the Simmons/Nowlands work) with slope, groundwater quality and flood-plain information to produce six general categories of suitability for residential development. The method used was a simple overlay-sieve mapping technique at a scale of 1:50 000. The analysis, intended for use in the Valley's regional planning program, has already found application in that area's municipal planning.

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(902) 424-4091

Case Study 6
Sand Bay-Cross Lake Terrain Analysis and Land Suitability Study, Manitoba
Submitted by Ross Thomasson, Manitoba Dept. of Renewable Resources and Transportation Services

The study area is located in an isolated Metis-Indian community (pop. 2 400) in north-central Manitoba, about 480 air km north of Winnipeg. Growth of the community led to demands for residential, recreational and agricultural land. Due to the area's varied physiography, careful terrain analysis was deemed necessary before development to minimize enviromental damage and other locational mistakes. A detailed biophysical survey of land adjoining the settlement was conducted with assessment of capability/suitability based on identified land types for the three uses. Airphoto interpretation was followed by ground truthing. A photomosaic displayed land types at 1:6 000. Because the initial product of the biophysical mapping program was too complex for general use, a land-type capability and suitability analysis was undertaken and supplied to the community.

It is too early to judge the project's value. Additional requests to conduct similar studies in other locations have been received, however.

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1495 St. James
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Information Resources

See also:
2.4 Soil
2.4 Land Use and Misuse
5.2 Information

B.C. Environment and Land Use Committee Secretariat. *Agriculture Land Capability in British Columbia.* B.C. Dept. of Agriculture (Parliament Buildings, Victoria. V8V 1X4), Sept. 1976. 44 pp.

B.C. Ministry of the Environment and Environment and Land Use Committee Secretariat. *A Land Use Planning Framework.* Ministry of the Environment, Resource Analysis Branch (Parliament Buildings, Victoria V8V 1X4), July 1977. 31 pp. Free.

A booklet presented in straightforward language and designed to provide a general understanding of the broad patterns of resource occurrence and land use in British Columbia. Land formation processes are described and the requirements and optimum development location of each resource or land use are illustrated as they affect the landscape. All resources and land uses are summarized on a common base to demonstrate the "mix of values" involved.

Dansereau, Pierre and Pare, Gilles. *Ecological Grading and Classification of Land-Occupation and Land-Use Mosaics.* Ottawa: Environment Canada, Lands Directorate, 1977. 63 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A OS9), catalogue no. EN36-506/58, $3.00.

Part I of the report reviews the principal and most influential systems for classifying land use and proposes a new system, more uniformly based on ecological criteria and less narrowly geared to the yields useful to man (a shift from use to occupation). Land is classified into four *panels*, reflecting four steps in the escalation of human impact on the world's landscapes: wild, rural, industrial and urban. Each is subdivided into seven *blocks* according to the predominant trophic level and energy output: mineral, vegetable, animal, industrial extension, transport, energy production, and manufacturing and services. A third unit, *type*, is also added. The result is an Ecological Land-Occupation scheme. A number of case examples are offered. Part II of the report discusses mapping, for which the ELO scheme is primarily devised.

Davis, L.S. and Henderson, J.A., "Land Classification Systems — The Needs of Land Use Planners", in *Proceedings of the American Institute of Foresters, 1976.*

Donihee, John. *An Evaluation of Land Classification Systems: Methods, Information and its Use.* York University, Faculty of Environmental Studies (4700 Keele St., Downsview, Ont. M3J 2R2), August 1977. 111 pp.

Unpublished major paper, part of M.E.S. program. Overviews land classification systems and examines land evaluation and the use/manipulation of environmental information systems and land evaluation analysis.

Dorney, R.S., "Biophysical and Cultural-Historic Land Classification and Mapping for Canadian Urban and Urbanization Land" in Wiken, E.B. and Ironside, G.R. (eds.). *Ecological (Biophysical) Land Classification in Urban Areas: Proceedings of a Workshop, Canada Committee on Ecological (Biophysical) Land Classification, 23 & 24 November 1976, Toronto.* Ecol. Land Class. Series No. 3, Environment Canada, Lands Directorate (Ottawa, K1A 0E7), 1977. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $4.00.

Proposes a method for mapping and classifying the cultural-historic, abiotic and biotic land features of land already urbanized, or soon to be, at scales of 1:500 to 1:25 000. The method is oriented toward encouraging a land-use planning process which addresses issues of environmental quality and environmental assessment. Opportunities and constraints are identified as well as ecological processes. The biotic mapping uses a three-tier system based on description, function and value of the resource area mapped. A case study (new town of Townsend, Ontario) is discussed.

Fraser, W.E. et al. (eds.). *Inventory Design and Analysis.* Society of American Foresters (5400 Grosvenor, Washington, DC), 1974. Paperback, 368 pp.

Goodchild, Michael F. *The Determinants of Land Capability.* Occasional Paper No. 7, Environment Canada, Lands Directorate (Ottawa K1A 0E7), June 1976. 63 pp. Free.

An examination of the relationships between two types of Canada Land Inventory capability indices: recreation and agriculture. Using a study area in south-eastern Manitoba the author develops methods to assess and use the identified relationships in land use planning.

Hills, G. Angus, Love, David V. and Lacate, Douglas S. *Developing a Better Environment: Ecological Land-Use Planning in Ontario, A Study of Methodology in the Development of Regional Plans.* Toronto: Ontario Economic Council, 1970. Paperback, 182 pp. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $3.00, cheque payable to Treasurer of Ontario.

Chapter 3 is titled, "The Classification and Evaluation of Land for Biological and Geographical Production". The proposed holistic system encompasses site classification, site evaluation, land classification and land evaluation. *Site classification* subdivides land/water into site units suitable for studying specific relationships between the physiographic environment and the biotic community it supports. Soil and climate features are most significant in classifying sites as *site regions* (areas within which similar combinations of soil and topography have similar climate and similar succession of plant communities) and subsequently as *land types* (areas combining soil texture, composition and depth such that similar patterns of plant communities occur) and *physiographic site types* (defined by soil moisture, local climate and more specific variations in soil depth, combinations of which result in narrow and identifiable range in natural vegetation succession and production – further subdivided into *site phase* which reflect the needs of specific types of biological products such as maps, forests or wildlife). Land is evaluated according to *use capability* (seven classes that indicate the land's potential to produce goods and services of various kinds under specified management conditions), *use suitability* (the productive capacity of an area in its present condition and the input required to bring the land up to this potential level of production) and *use capability* (the relative advantage of using a specific area for a specific type and intensity of use). Land classification involves dividing larger areas into multiple-use regions, landscape units, site associations and site places, then grouping back upward for purposes of development planning. A case study of the Simcoe region in Ontario demonstrates an application of this complex and difficult approach which forms the basis for the Ontario Land Inventory and influences much of the work on soil/land classification in the province.

Hoffman, D.W. and Noble, H.F. *Acreages of Soil Capability for Agriculture in Ontario.* ARDA Report No. 8, 1975. Supply and Services Canada (Printing and Publishing, Ottawa K1A OS9).

Hoffman, D.W. *Assessment of Soil Productivity for Agriculture.* ARDA Report No. 4. Ontario Ministry of Agriculture and Food (1200 Bay St., Toronto), 1971.

Summary comparison of methods (Hopkins)

Method	Handles interdependence of factors	Explicit identification of regions	Explicit determination of ratings	Additional comments	Example
Gestalt	Yes	No	No		Hills (1961)
Mathematical combination					
Ordinal combination	No	Yes	Yes	Involves invalid mathematical operations	McHarg (1969) pp. 31-41
Linear combination	No	Yes	Yes		Ward and Grant (1971)
Nonlinear combination	Yes	Yes	Yes	Required functional relationships generally not known	Voelker (1976) pp. 49 ff.
Identification of regions					
Factor combination	Yes	Yes	No	Requires a very large number of evaluative judgments	Wallace-McHarg (1964)
Cluster analysis	Yes	Yes	No		Rice Center (1974)
Logical combination					
Rules of combination	Yes	Yes	Yes		Kiefer (1965)
Hierarchical combination	Yes	Yes	Yes		Murray et al. (1971) pp. 131-74

Hopkins, Lewis D., "Methods for Generating Land Suitability Maps: A Comparative Evaluation", *Journal of American Institute of Planners*, Oct. 1977, pp. 388-400.

Develops a general statement of the purpose and character of land suitability analysis, a taxonomy of existing methods for identifying homogenous areas and rating them as to suitability for specific uses, and a comparative evaluation of these methods.

Jurdant, M. et al. *L'inventaire du Capital-Nature — Méthode de Classification et de Cartographie Écologique du Territoire.* Ottawa: Environment Canada, 1977. Hardcover, 202 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), cat. no. EN73-3/2F. $7.00 ($8.40 outside Canada). English text in preparation.

This book describes the method of ecological land classification and inventory used by Le Service des Études écologiques régionales. The inventory method, applicable to various settings in Canada, has been tested in the Saguenay/Lac-St-Jean and James Bay regions.

Lacate, D.S. (comp). *Guidelines for Biophysical Land Classification.* Ottawa: Queen's Printer, 1969. 61 pp.

Report of the Subcommittee on Biophysical Land Classification. Drew heavily on the following earlier works: G. Angus Hills, *The Ecological Basis for Land-Use Planning* (Ontario Dept. of Lands and Forests, 1961); C.S. Christian, "The Concepts of Land Units and Land Systems", *Proceedings of 9th Pacific Science Congress*, 1957; R. Bourne, *Regional Survey and its Relation to Stocktaking of the Agricultural and Forest Resources of the British Empire* (Oxford: Clarendon Press, 1931); O.H. Beckett and R. Webster, *A Classification System for Terrain* (Hamphire: Mil. Engineering Experimental Establishment, 1965); and V. Sukachev and N. Dylis, *Fundamentals of Forest Biogeocoenology,* translated from Russian (Edinburgh: J.M. Maclennan, 1964).

Lopoukhine, N.A. et al. *The Ecological Land Classification of Labrador: A Reconnaissance.* ELC Series No. 4, Environment Canada, Lands Directorate, Atlantic Region (P.O. Box 365, Halifax B3J 2P8), 1978. 85 pp. Free.

May, Lynne, "The Present Role of Biophysical Information in Urban and Regional Land Use Planning in Canada", in Wiken and Ironside, 1977, cited under Dorney, above.

McBoyle, G.R. and Sommerville, E. (eds.). *Canada's Natural Environment: Essays in Applied Geography.* Toronto: Methuen, 1976. Paperback, 264 pp. $8.95.

Part 4, "Soil and the Management of Land in Canada", comprises two papers: Hoffman, "Soil Capability Analysis and Land Resource Development in Canada"; and White, "Soil Properties and Soil Engineering in Canada".

Metropolitan Area Planning Commission. *Halifax-Dartmouth Metro Area, Natural Land Capability.* Halifax: Dept. of Development, 1973. 71 pp.

Annotated in 2.3 Water Quality.

Rees, W.E. *The Canada Land Inventory in Perspective.* Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1977. Paperback, 40 pp.

Smithsonian Institution, Office of International and Environmental Programs, Center for Natural Areas. *Planning Considerations for Statewide Inventories of Critical Environmental Areas: A Reference Guide.* Washington, DC: Dept. of the Army, 1974. Paperback. 274 pp. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), NTIS 622451515 C, $6.50.

Appendix D, pp. 187-231, reviews a number of environmental rating systems and capability classification schemes.

Thie, J. and Ironside, G. (eds.). *Ecological (Biophysical) Land Classification in Canada. Proceedings of the First Meeting, Canada Committee on Ecological (Biophysical) Land Classification, 25-28 May 1976, Petawawa, Ontario.* Ecol. Land Class. Series No. 1, Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1976. 269 pp.

The first meeting of the Canada Committee which picked up the work of the National Committee of Forest Land, 1966-72. Twenty-four papers set out the current status of ecological (biophysical) land classification in Canada, developments in land classification methods, and classification project reports (Mackenzie Valley, Eastern Melville Island, Boothia Peninsula and Northern Keewatin, James Bay, Northern Manitoba, Banff and Jasper, Yukon). A summary of the business sessions which established the Committee, its terms of reference, its immediate activities and five working groups (Methodology and Philosophy, Applications, Data Systems, Wetland, and Land/Water Intergration) is included.

University of Guelph, Centre for Resources Development. *The Evaluation of Alternative Methodologies for Rural Land Evaluation.* University of Guelph, Centre for Resources Development (Guelph, Ont. N1G 2W1), Publication #82, March 1977. Paperback, 112 pp.

Vink, A.P.A. *Land Use in Advancing Agriculture.* New York: Springer Verlagh, 1974. Hardcover, 394 pp. $28.50.

Draws on the work of European researchers, focusing on land use and land evaluation, but virtually ignores the Canadian contribution.

Vold, Terje. *Biophysical Soil Resources and Land Evaluation of the Northeast Coal Study Area 1976-1977.* B.C. Ministry of the Environment (Resource Analysis Branch, Parliament Buildings, Victoria V8V 1X4), March 1978. 68 pp. Free.

Part of the Northeast Coal Study. The rationale given for a soil resource inventory is that (a) considerable financial savings can result if the most appropriate soils are used for land developments, (b) all renewable resources are dependent upon soil (a non-renewable resource) which necessitates soil conservation to provide sustained yields of agricultural crops, timber and forage for wildlife, and (c) understanding of soil capability is essential to deal with problems associated with land resource allocation. The report describes and maps the soils of the study area, interprets them with respect to suitability for various uses (agriculture, forestry, wildlife, recreation, certain public works, and visual resources), and provides basic data for environmental impact assessment and resource planning. It goes beyond the CLI in presenting capability ratings; e.g., those for forestry include an overall rating of capability, dominant coniferous species, limitations for regeneration, wind throw hazard, logging road limitations, and erosion hazards. Similar reports are available for the Smithers-Hazelton area (1972) and the Nechako-François Lake area (1974).

Webber, L.R. and Hoffman, D.W. *Origin, Classification and Use of Ontario Soils.* Toronto: Ontario Ministry of Agriculture and Food, n.d. 58 pp. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $0.50.

Wiken, E.B. *Ecological (Biophysical) Land Classification: An Analysis of Methodologies.* Environment Canada, Lands Directorate (Ottawa K1A OE7), 1978. 79 pp. Free.

Wiken, E.B. and Ironside, G. "The Development of Ecological (Biophysical) Land Classification in Canada", *Landscape Planning*, 4 (1977), pp. 273-275.

Land Use and Misuse

Various activities compete for the use of land. Conflicts especially occur among competing uses at the land/water interface (see 3.4 Marine Coastal Zone), on major resource developments (see 4.4 Resource Development) and in the urban fringe (see 3.7 The Rural-Urban Fringe). Manning and McCuaig (1977) report that 44% of the total value of Canadian agricultural production in 1971 – and 54%, 19% and 20% respectively of its Class 1, 2 and 3 agricultural land – was derived from land lying within 80 km of the 19 Census Metropolitan areas. Strong competition for use of the land in this zone, which is also the urban commutershed, is apparent.

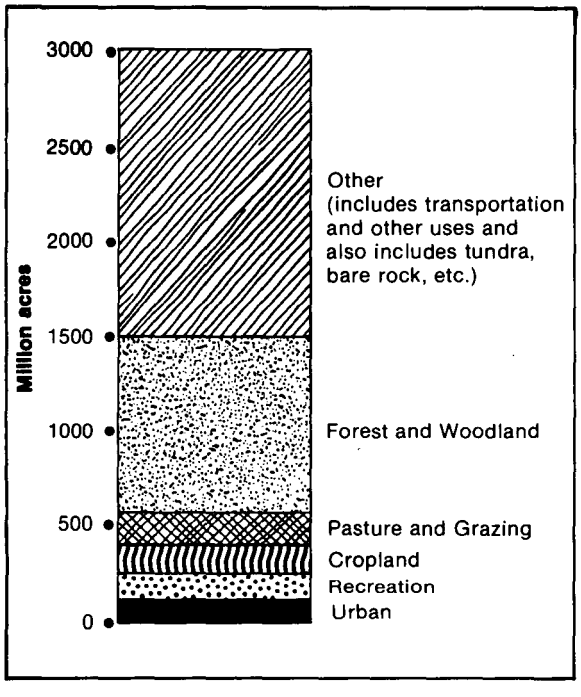


Figure 2.5 Land Use in Canada

Source: Douglas W. Hoffman, "Soil Capability Analysis and Land Resources Development in Canada", in G.R. McBoyle and E. Sommerville (eds.), *Canada's Natural Environment: Essays in Applied Geography* (Toronto: Methuen, 1976). Reproduced with permission.

When conflicts occur, priorities must be set. If the market sets the priorities, single interests and short-term gain tend to prevail and the potential of the land resource is not fully realized (or worse). Public planning, backed by government control over the use and making-usable or servicing of land, is required to introduce the necessary public interest component into private decisions, to achieve the necessary coordination among public and private interests, and to correct the imbalance between resource and commodity with respect to land.

Public land use planning exists now, in various forms and for various purposes: resource development (e.g. forestry), major services and facilities (such as transportation, water, waste disposal, energy supply) and urban/regional development generally. Often, however, such planning is hampered by lack of commitment to it, narrow perspectives, inter-organizational rivalry, lack of coordination among competing interests, and inadequate legal instruments to exercise the necessary controls. Futhermore, conventional land use plans tend (a) to give low priority to environmental concerns, (b) to be urban-biased, regarding undeveloped land as "raw", and natural or rural areas as reservoirs for future urban expansion, and (c) to treat natural features as amenities supporting development or barriers to it, best removed and replaced after the site is cleared and built on (e.g. instant trees). Such land use planning is oriented more towards *use* than towards *land.* Add the countless activities for which there is little or no land use planning whatsoever and the result, from an environmental perspective, is land misuse:

Mechanical interference with the soil. Conventional urban development concentrates runoff and causes it to proceed directly to streams rather than returning to the soil and seeping down to the water table. Building in unstable areas may cause soil movement leading to property damage. Careless agricultural and forestry practices which remove anchoring plant life can lead to erosion and the loss of valuable topsoil through wind and water action. Improper irrigation which raises salt levels renders areas unfit for further growth. Construction of dams with settling basins traps sediment which might otherwise nourish beaches. Construction of coastal structures such as breakwaters, while bringing benefits, can alter the distribution of shoreline materials thereby destroying recreation resources and causing unforeseen erosion. Construction in highly sensitive areas such as permafrost, can bring substantial permanent damage to land and property, unless very carefully done. Clearing of large tracts of land, and omitting buffer zones between watercourses and intensive development, creates erosion, sedimentation and disruption of natural systems.

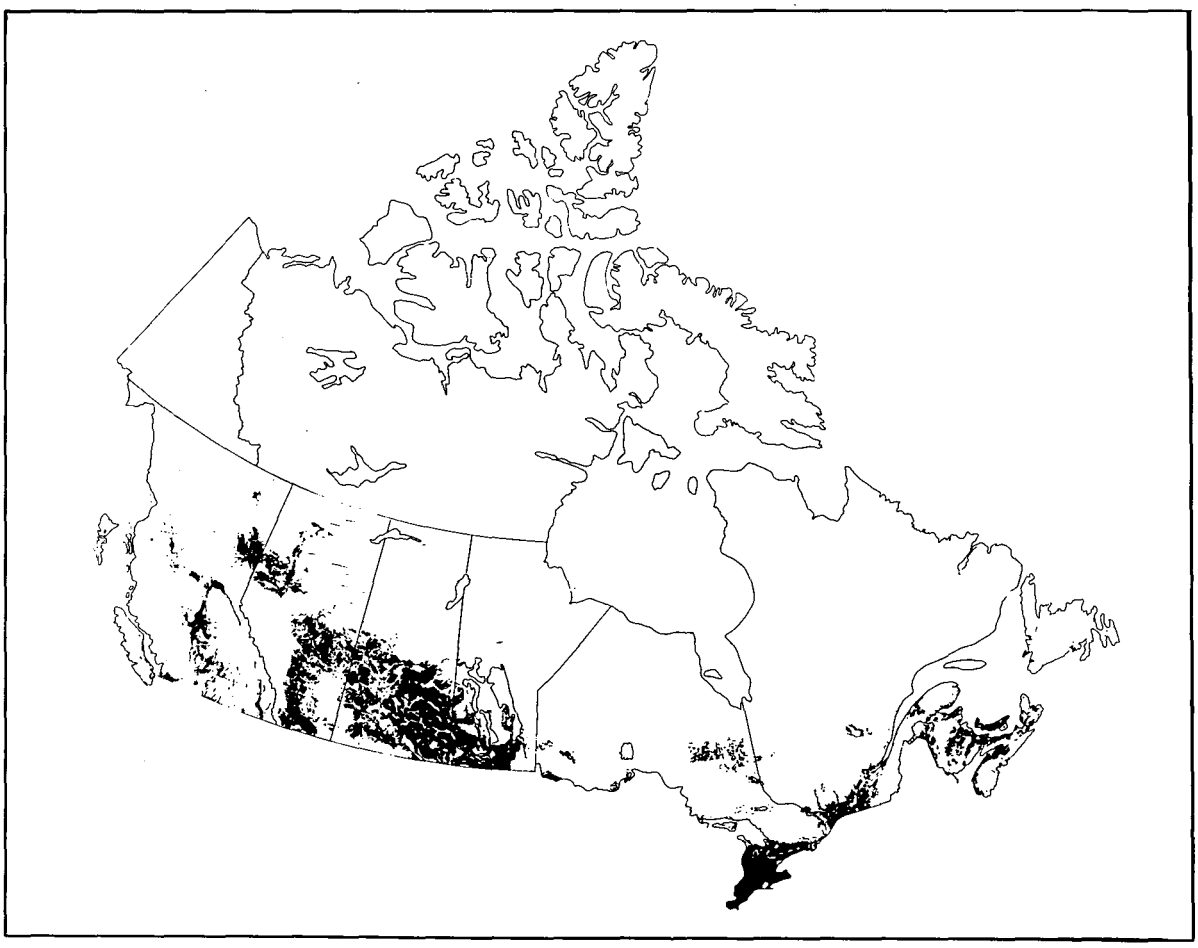


Figure 2.6 Canada's Prime Agricultural Land

Source: E.W. Manning and J.D. McCuaig, *Agricultural Land and Urban Centres* (Ottawa: Environment Canada, Lands Directorate, July 1977). Shown are agricultural capability classes 1-3 for all provinces except British Columbia and Newfoundland where classes 1-4 are indicated.

Subsidence of land often follows mining operations and withdrawal of fluids (water, oil, gas) from the soil. Strip mining of aggregate materials, coal and other minerals can create erosion, expose substance which leak into and poison the soil, alter the groundwater regime and permanently disfigure the landscape. Compaction of the soil (by heavy machinery, recreation activities, etc.) can detrimentally affect its capacity to sustain life. Derelict land, evident in every part of Canada, is the final result of these practices.

Chemical degradation of the soil. Fertilizers and pesticides alter the soil's biochemical balance by killing organisms that maintain its porosity and aeration. Heavy metals, contained in liquid industrial wastes many of which are simply dumped in rural areas, and industrial effluent as well pollutants from the air, contaminate the soil and may be carried into food consumed by man (a topical example is urban gardens). Air pollutants such as sulfur dioxide mix with water and disturb soil acidity to the detriment of plants and animals. Land pollution occurs directly through practices such as improper municipal and industrial sanitary landfill operations and through faculty use of septic tanks.

Biological disruption. Biologically sensitive areas, rich in plant and animal life (marshes, for example), when polluted suffer a reduction in species diversity and loss of the essential functions they perform, such as the trapping of sediment and pollutants. Urban development, agriculture, forestry, mineral exploration and recreation all contribute to the disruption of wildlife habitats and instability of plant and animal communities. Consequences include loss of valued organisms, over-abundance of undesirable life forms, and the eventual extinction of certain species.

Cultural disruption. Implicit in the foregoing, cultural disruption also occurs in forms such as unnecessary interference with ways of life (especially of people who are close to the land), attrition of historic and archaeological features, loss of valued scenic resources, and reduction of aesthetic enjoyment. Underneath it all is the sense of depression that accompanies the news that yet another invaluable environmental resource has become merely a memory.

Improper allocation of use of land. Narrowly based land use planning can: create unnecessary hazards (e.g. allowing buildings in floodplains, over fault lines, in areas of unstable subsurface conditions); pre-empt land for other uses (e.g. urban development permanently cancels out the unique value of lands with high potential for agriculture); fail to protect environmental resources, those valued by man for his use (such as the aquifers that supply well water for a community) and those valued for their own sake (scenic views, unique habitats, historic remnants, etc.); and generate unnecessary costs for later remedial action.

Land use and environmental quality are related. A recent study (Croke, 1973) concluded:

> *Despite the fact that current environmental control practices consider the present and future distribution of pollution-producing sources, they remain technology oriented and accord only peripheral recognition to the en-*

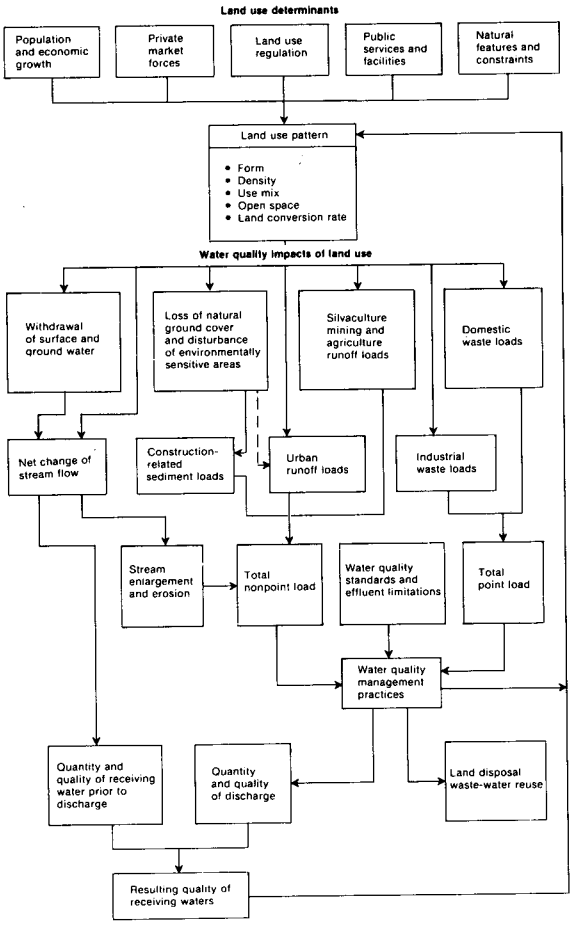
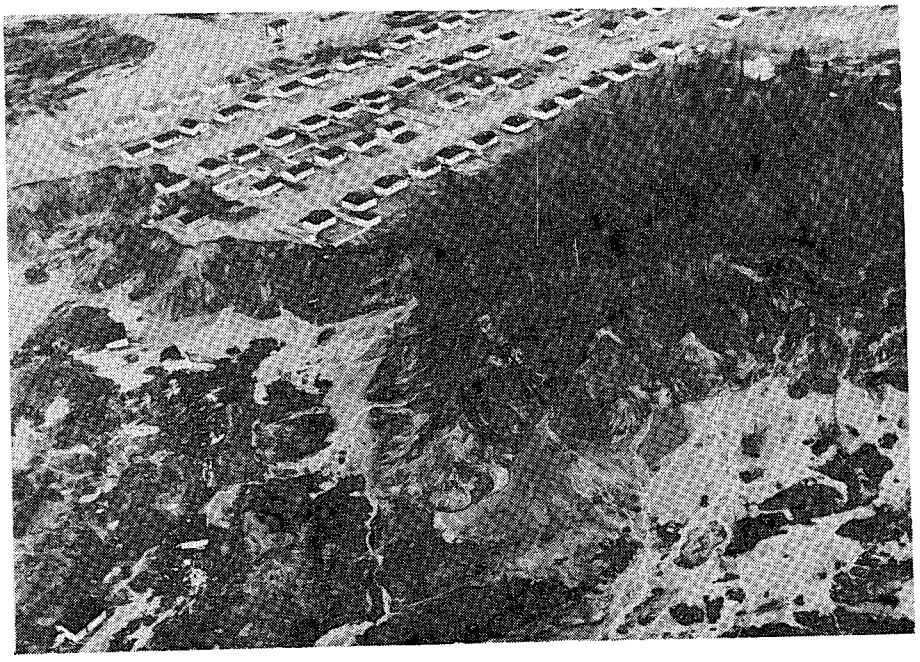


Figure 2.7 Land Use/Water Quality Relationships

Source: Larry W. Canter, *Environmental Impact Assessment* (New York: McGraw-Hill, 1977).



vironmental/land-use quality relationship. . . .

In principle, at least, the type and intensity of land development and the attendant waste-generation processes can be matched to the capacity of the land resource to assimilate environmental pollutants without unacceptable degradation of environmental quality. . . .

. . . .there is a fairly close relationship between the types and quantity of environmental pollutants produced by a given parcel of land and the use and level of intensity to which that land has been developed. . . . It follows, in principle at least, that controls imposed on the distribution and intensity of land use should be at least as effective, and substantially more flexible, than source-oriented technology controls (because land-use-based restrictions on pollutant emissions need not be linked explicitly to any specific process or emission control schemes).

Case Study 7
Rapid Decline in Soil Quality Endangers Prairie Land

Soil scientists report that the rich Saskatchewan soils, which took 10 000 years to develop, have lost 40-50% of their organic content less than a century after farmers first broke the land. Professors Donald Rennie and J.G. Ellis of the Soil Science Department of the University of Saskatchewan, warn that the drop in productivity is so grave that "it could seriously endanger the future prosperity of agriculture in the province".

A compounding factor is that in the past 20 years three million acres of the province's best land and 7% of its total cropland have been infiltrated by salts, and the loss is continuing. The drop in soil organic matter has weakened the soil structure, increased its susceptibility to erosion, raised the odds of repeating the thirties dustbowl, and reduced the soil's ability to hold water. This has increased the amount of runoff which in turn raised the water table. The additional water is finding its way to the salt layer, then again moving to the surface this time laden with salts that kill plants. Wheat production in most salt-affected areas has dropped 50% and the protein in wheat has declined sharply (requiring more fertilizer to compensate, with increased costs).

Farmers mining the soil – taking out more nutrients than they are replacing – is the cause. Much of this is inadvertent, through the traditional practice of summerfallowing (leaving land idle for one growing season) which, contrary to popular belief, produces a net nutrient loss. Many of the nutrients, with no crop to absorb them, evaporate or leach down below the soil surface out of reach of the next year's crop. The report recommends that farmers significantly decrease their summerfallow acreage, but it admits the unpopularity of such a move with economists and others concerned with over-production.

See: D.A. Rennie and J.G. Ellis, *The Shape of Saskatchewan*, University of Sask. (Dept. of Soil Science, Saskatoon, Sask.), 1978.

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Case Study 8
Crane Driver Dies Beneath Tons of Clay
Submitted by David Brown, McGill University.

A beam being driven into the ground to support a 750 kV transmission tower touched off a massive landslide near Rigaud, Quebec. Within 35-40 seconds, gently rolling pasture lands covering nearly three acres were transformed into a massive pit 30 to 50 feet deep punctured with sharp peaks of clay. A worker operating a crane was buried when the earth opened beneath him. Exact cause of the slide has not been established though vibrations from the pile driver and general wetness of the clay in the spring are suspected as contributing factors.

The route for the transmission line had been chosen following elaborate impact studies prepared by engineering, urban planning and ecological consulting firms, according to the *Montreal Star* (4 May 1978, p. A-1).

Information Resources

See also:
2.4 Erosion
3.7 The Rural-Urban Fringe
4.1 Agriculture
4.2 Urbanization

Berry, Brian J.L. et al. *Land Use, Urban Form and Environmental Quality.* University of Chicago (Dept. of Geography, 5828 S. University Ave., Chicago, IL 60637), 1974. Paperback, 440 pp. $5.00.

The result of a research project on the ways in which urban form and land use affect the nature and intensity of environmental pollution, within and between urban regions. Sections cover air quality, water quality, solid waste, noise, pesticides, radiation, nationwide relationships of pollution to city characteristics (considering each of the above), and the environmental consequences of alternative urban futures. Described further as Case Study 56 in 4.2 Urbanization.

Browning, Frank. *The Vanishing Land: Corporate Theft of America's Soil.* New York: Harper Colophon Books, 1975. Paperback, 199 pp. $3.95.

The author argues that land, the one thing Americans turn to in time of crisis, their symbol of independence and personal enterprise, is disappearing. It is being gobbled up by multinationals and other large corporations, banks and insurance companies who dominate American financial life, land developers, and agribusiness.

Croke, Edward J., "An Evaluation of the Impact of Land Use on Environmental Quality", in Donald M. McAllister (ed.). *Environment: A New Focus for Land-Use Planning.* Washington, DC: National Science Foundation, 1973. Paperback, 328 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Catalogue NS1.2:EN8, $3.75 + 25% outside U.S.A.

Found, William C. *A Theoretical Approach to Rural Land-Use Patterns.* London: Edward Arnold, 1971. Paperback, 190 pp. $3.75.

Fuller, W.A., "Land Use in Canada's North", in Krueger, Ralph R. and Mitchell, Bruce (eds.). *Managing Canada's Renewable Resources.* Toronto: Methuen, 1977. Paperback, 333 pp. $9.95.

Gierman, D.M. *Rural to Urban Land Conversion.* Occasional Paper No. 16, Environment Canada, Lands Directorate (Ottawa K1A 0E7), Sept. 1977. 74 pp. Free.

Loss of farmland and land with high capability for agriculture is a growing concern in Canada. This study focuses on the amount of rural land lost to direct urbanization during the period 1971-76 in and around the 71 urban areas with a population of 25 000 or more in 1971. Shown for each area is the total rural land converted to urban uses, along with the former use and its level of capability for other uses; e.g., Canada's largest urban area, Metro Toronto, used up 29 047 acres of prime farmland, the largest amount for any city in the country (Alberta experienced the greatest increase in its urban land area and Red Deer had the highest percentage increase, 57.5%). Canada's cities spread across more than 100 acres of rural land every day during the 1966-71 period and the trend continues. The report says the prime agricultural land now being lost will be needed in 25 years to feed Canada's own population. But more than half this land is within 50 miles of Canada's 19 largest cities, and cleared farmland is preferred for urban building.

Hendler, Bruce. *Caring for the Land: Environmental Principles for Site Design and Review.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637) 1977. Paperback, 93 pp. $8.00.

A straightforward, nontechnical book aimed at local planning officials and laymen interested in learning about general principles of site design and review as well as about the review process itself. Visually effective presentations not only of what to do (e.g. in considering hazard areas) but also what can happen if this isn't done (i.e. if hazard areas are disregarded).

Keyes, Dale L. *Land Development and the Natural Environment: Estimating Impacts.* The Urban Institute (2100 M St. NW, Washington, DC 20037), 1976. Paperback, 128 pp. $4.95.

Annotated in 5.5 Environmental Impact Assessment and elsewhere.

Lang, Reg and Armour, Audrey. *Municipal Planning and The Natural Environment.* Toronto: Ontario Planning Act Review Committee, Sept. 1976 (published 1977). Paperback, 90 pp. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $1.25 cheque payable to Treasurer of Ontario.

Detailed study of the natural-environment component in municipal "Official Plans" in Ontario. The study found such plans to be weak in their treatment of natural environment concerns; natural environment to most municipalities means natural hazards, pollution and aesthetics. Reasons for this lack are presented, barriers and problems are identified, and improvements (mainly to the Planning Act) are recommended, organized within a framework of environmental management. Summarized in Reg Lang, "The Natural Component in Ontario's Municipal Plans", in Wiken, E.B. and Ironside, G.R. (ed.). *Ecological (Biophysical) Land Classification in Urban Areas. Proceedings of a Workshop, Canada Committee on Ecological (Biophysical) Land Classification, 23 & 24 November 1976. Toronto.* Ottawa: Environment Canada, 1977. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $4.00.

Manning, E.W. and McCuaig, J.D. *Agricultural Land and Urban Centres: An Overview of the Significance of Urban Centres to Canada's Quality Agricultural Land.* CLI Report No. 15, Environment Canada, Lands Directorate (Ottawa K1A 0E7), July 1977. 16 pp. Free.

Matthews, W.H. et al. (ed.). *Man's Impact on Terrestrial and Oceanic Ecosystems.* Cambridge, MA: MIT Press, 1971. Hardcover, $25.00.

Nelson, J.G. *Man's Impact on the Western Canadian Landscape.* Toronto: McClelland and Stewart (Carleton Library No. 90), 1976. Paperback, 205 pp. $4.95.

Rawson, Mary. *Ill Fares the Land. Land-Use Management at the Urban/Rural/Resource Edges: The British Columbia Land Commission.* Ministry of State for Urban Affairs (Ottawa K1A 0P6), 1976. 45 pp. Free.

The author, a former member of the Commission, describes its rationale and experience with a look into the future concerning how far provincial intervention in land use might be taken.

Reilley, William K. (ed.). *The Use of Land: A Citizens' Policy Guide to Urban Growth.* New York: Thomas Y. Crowell Co., 1973. Paperback, 318 pp. $3.95.

Report of the Task Force on Land Use and Urban Growth, created by the Citizens' Advisory Committee (to the President) on Environmental Quality. Addresses the problem of how to organize, control and coordinate the urban development process so as to protect what Americans most value in the environmental, cultural and aesthetic characteristics of the land while meeting essential needs of a changing population for new housing, roads, power plants, shopping centres, parks, businesses and industries. The book challenges the growth ideal while acknowledging that some growth is inevitable; argues for a conservation approach; explores ways to adapt existing laws and create necessary new instruments for creating incentives and regulating development to achieve environmental quality; and considers the role of the citizen in conservation and development.

Soil Conservation Society of America. *Land Use: Tough Choices in Today's World.* SCSA (7515 Northeast Ankeny Road, Ankeny, Iowa 50021), 1977. 454 pp. $7.00.

Proceedings of national symposium, March 1977 in Omaha, Nebraska, that dealt with demands for agricultural, urban and natural open space in the United States and Canada.

Swan, Hedley. *Federal Lands: Their Use and Management.* Land Use in Canada Series No. 11, Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1978. 110 pp. Free.

Deals with the effect of federal land ownership on land use, discusses the federal land management policy of combining provision of service with wider social/economic/environmental considerations (its major effect, the report concludes, will be in urban areas), reviews land management practices of several departments and agencies, and provides facts and figures on the location, quantity and use of federally owned land.

Ward, E. Neville. *Land Use Programs in Canada: Ontario.* Ottawa: Environment Canada, Lands Directorate, Sept. 1977. Paperback, 198 pp. Available from

Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $1.25.

One of a series of reports that provides an overview of land use planning in each of the 10 provinces (forthcoming for Yukon and Northwest Territories). Chapters cover the historical context of land use planning in Ontario; how the provincial government is organized to formulate policy and plan with respect to land use; a review of environmental programs in the province; and detailed information on urban settlement (population growth, urban planning, governmental organization for planning and housing, etc.), agriculture, forestry, recreation, fish and wildlife, energy, mining and quarrying, transportation, and water.

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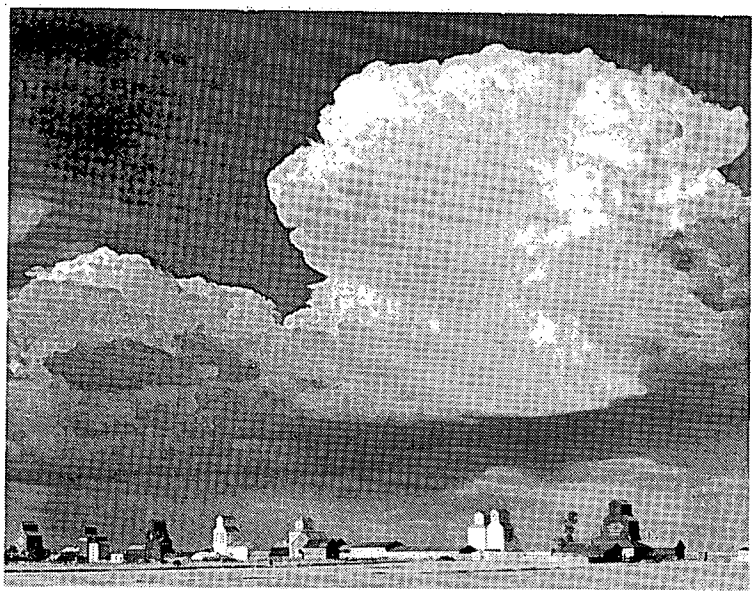
2.2 Air

Life on earth exists in a film of air, water and soil only about nine miles (14 to 15 km) thick. What we call air is the layer of usable atmosphere above us, which is seven miles, or about eleven kilometres deep.

Although air is the least visible of the environmental resources, it is hardly the least important. Each of us needs about 30 pounds (less than 14 kg) of relatively pure air each day to survive. Air similarly sustains other forms of life on which man depends or which he otherwise values. The atmosphere itself absorbs solar radiation to create the climatic conditions favourable to life on this planet. It also shields us from harmful rays, stores moisture and provides an arena for weather.

Air-related concerns are:

1. To minimize harmful effects of air and climate on human activities, and vice versa, while taking full advantage of the benefits offered by this environmental resource. This relates to the way human settlement is planned and designed, especially at the micro scale, and to larger questions of human activity on the planet.
2. To ensure a quality of air compatible with human health and well-being. This relates to the planning and ongoing operation of urban areas and regions.



Climate

Weather commonly refers to temperature, pressure, wind, humidity, cloud and precipitation. Climate is an area's characteristic weather over a long period. Climate depends on latitude, moving air masses both local and long-distance, the relative distribution of land and water and other local landforms.

The climatic system gets most of its energy from the sun. About 30% of the sun's radiation is reflected back into space by air molecules, clouds, dust and the earth's surface, leaving the remainder to warm the planet. The average surface temperature of the earth is determined, first, by the earth's reflectivity (called the planetary albedo) and second, by the nature and quantity of gases and particles available in the atmosphere to absorb, scatter or emit infrared radiation. When these two factors are affected, climatic change can result. Because climate is truly an example of everything being interconnected, climatic changes in one region, whether caused by natural factors or human impact, are likely to be related to changes in another region.

Of particular concern in relation to climatic change are four effects of human activity:

1. Increases in carbon dioxide, caused by burning of fossil fuels and by the recently discovered world-wide destruction of forests. CO_2 absorbs radiant energy in infrared wavelengths. Increased CO_2 in the air means warmer surface temperatures on the planet (the greenhouse effect). Present levels are 290-330 parts per million. A level of 400 ppm, expected before the year 2000, could cause a temperature increase of 1°C, as great as any global change observed in the past thousand years (Schneider, 1977). Doubling of the present levels of CO_2 will occur by 2020 if present trends continue (Woodwell, 1978), thereby enlarging arid parts of the globe and significantly affecting agricultural production and many other human activities. It is questionable whether enough carbon will be stored in forests and oceans to avert major climate change. On the other hand corrective action, to restrict without delay fossil fuel consumption and the rate of forest clearing, could be equally disruptive.
2. Pollution of the air by dust and other particles, which can have a cooling effect by preventing sunlight from reaching the earth.

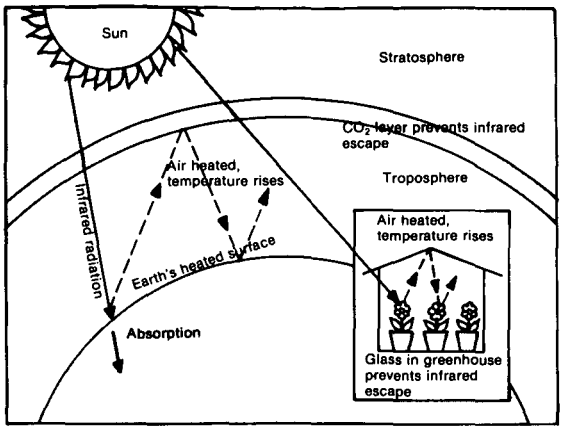


Figure 2.8 The Greenhouse Effect

3. Heat generated to produce electricity, and other thermal pollution, especially from cities.
4. Overgrazing and other destruction of vegetation, followed by agriculture and urbanization, which affect the amount of solar energy absorbed and the rate of water evaporation from the surface.

Whether the net result is an overall cooling or warming effect on the earth as a whole remains uncertain. And whether the effects would be positive or negative depends partly on the scale under consideration (some places would welcome a slightly warmer or cooler climate). These changes are being watched closely because climatic change could introduce further instability into world agriculture. During recent years world food output has declined; world food reserves have fallen from a 95-day supply to enough to last only a month. Half the people in the world today suffer from hunger or malnutrition or both. Countries previously able to grow sufficient food to meet their needs are increasingly driven to import food from a dwindling number of producers, Canada among them. If recent trends continue, North America will soon be supplying much of the world's food. Even Canada, however, is self-sufficient only in wheat, feed and dairy products; in all other areas, we *import* more than we export. Climatic change reducing the capacity of other countries to produce their own food would increase the demand for Canada's agricultural products. But accelerating energy costs (agriculture being highly energy-intensive), loss of prime agricultural land to non-farm use and increased soil deterioration, cast doubt not only on Canada's

ability to produce more food for the world but to produce enough for its own growing population – and that overlooks problems of distribution *within* the country where most of the provinces are net importers of food.

All of this emphasizes the significance of protecting prime agricultural land, a valuable resource made so in large measure by climate. "Climatic suitability", however, also relates to other activities of concern to the environmental planner including forests, wildlife, outdoor recreation and the various factors that affect human settlement.

Information Resources

See also:
2.2 Climate and Human Settlement

Eagleman, J.R. *The Visualization of Climate.* Toronto: D.C. Heath, 1976. Hardcover. $15.95.

Fisheries and Environment Canada, Atmospheric Environment Service. *Energy and Climate: An Assessment of Relationships Between the Consumption and Production of Electricity in Ontario, and the Climate.* Toronto: Royal Commission on Electric Power Planning (14 Carlton St., 7th Floor, Toronto M5B 1K5), May 1977. 78 pp. Available from RCEPP at xerox cost ($4.20, cheque payable to Treasurer of Ontario).

Annotated briefly in the next section.

Hare, F. Kenneth and Thomas, Morley K. *Climate Canada.* Toronto: Wiley, 1974. Hardcover. 256 pp. $11.50.

A simple descriptive account of Canada's climates and their interaction with man. Sections cover an introduction to the various climates found in Canada; general climatology including physical and dynamic climate (patterns of energy exchange and various substances at the earth's surface over time); the regional climates of Canada; climate and human activity including agriculture, economic activity, shelter, recreation and urban areas; meteorological data and services including sources of Canadian climatic data; and the data themselves, in an appendix.

Landsberg, Helmut E., "Man-Made Climatic Change", *Science* 170, No. 3964, 10 Dec. 1970, pp. 1265-1274.

Landsberg, H.E. *Weather and Health: An Introduction to Biometeorology.* Doubleday Anchor, 1969. Paperback, 148 pp. $1.45.

Biometeorology deals with the relations between atmospheric and life processes. Human life depends on careful maintenance of equilibrium between internal and environmental factors over rather narrow limits (e.g., core body temperatures above 40°C and below 18°C can only be tolerated briefly). Urban and industrial development may upset these balances, creating unprecedented hazards to physiological health (Chapter 8, City Climate) and personal comfort. Human behaviour and performance may also be affected. Evidence suggests that weather and changes in it contribute to disease (feeling "under the weather") especially rheumatism, arthritis, heart disease, asthma and allergies and infectious diseases. Weather may also contribute to the healing process.

Matthews, S.W., "What's Happening to Our Climate?" *National Geographic,* 150 (5), Nov. 1976, pp. 576-615.

McBoyle, G.R. and Sommerville, E. (eds.) *Canada's Natural Environment: Essays in Applied Geography.* Toronto: Methuen, 1976. Paperback, 264 pp. $8.95.

Part 2, "The Value of Climate and Weather in Canada", comprises two papers: McKay, "Climatatic Resources and Economic Activity in Canada"; and Gardner, "Natural Hazards of Climatic Origin in Canada".

Schneider, Stephen H. with Mesirow, Lynne F. *The Genesis Strategy: Climate and Global Survival.* New York: Dell Publishing Co., 1977. Paperback, 419 pp. $5.70.

This book examines the relationship between climate and food, technology, population, energy, pollution and politics. It warns of potential world-wide climate-related problems and proposes, as a hedge against catastrophe, a "Genesis Strategy" (in the Book of Genesis, Joseph advises the Pharaoh to store food during the years of plenty to ensure Egypt's survival in

the lean years to come). If we simply make predictions and then wait to see if they come true – "let nature do the experiment" – by the time such proof is obtained it will be much too late to take corrective action. A series of proposals follows, based on planning for adversity by maintaining diversity and by providing ample margins of safety in matters basic to global human survival.

Sellers, William D. *Physical Climatology*. Chicago: University of Chicago Press, 1965. Hardcover, 272 pp. $11.50.

Woodwell, George M. "The Carbon Dioxide Question", *Scientific American*, Vol. 238, No. 1, Jan. 1978, pp. 34-43.

Climate and Human Settlement

In the early days of human settlement in Canada, a prime concern was how people could protect themselves from the elements, which translated mainly into the need for shelter. Effects of (rather than to) the natural environment were uppermost in the minds of natives and settlers. Today, climate and weather still command healthy respect and certain problems, such as snow clearance and flooding, remain formidable. But modern technology *seems* to have overcome most of the earlier problems at the urban scale. So much so that concern is beginning to swing the other way, that is, to the effects of human settlement on air and climate, and how these in turn can affect the quality of urban life.

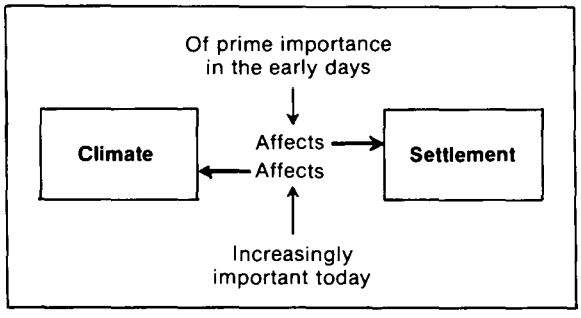


Figure 2.9 Climate vs. Human Settlement

Source: Reg Lang and Audrey Armour, *Oakville Environmental Report: A Case Study in Environmental Planning* (Toronto: Lang Armour Associates, 1977). Reproduced with permission. Adapted from: T.R. Oke, "The Significance of the Atmosphere in Planning Human Settlements", in E.B. Wiken and G.R. Ironside (eds.), *Ecological (Biophysical) Land Classification in Urban Areas. Proceedings of a Workshop, Canada Committee on Ecological (Biophysical) Land Classification, 23 & 24 November 1976, Toronto, Ontario* (Ottawa: Environment Canada, Lands Directorate, 1977).

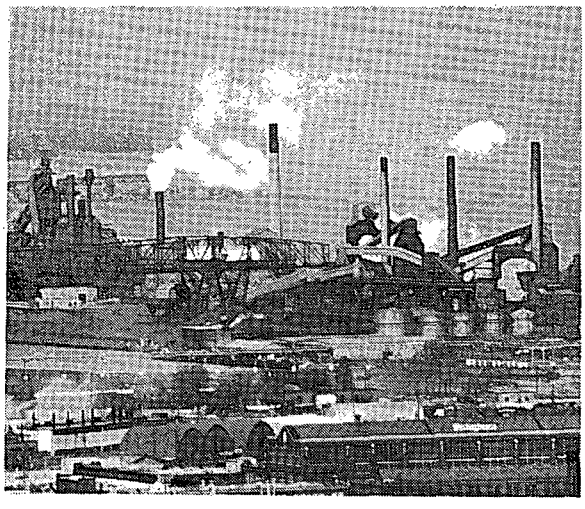
The most important aspects of climatic impact on the human environment are solar radiation, temperature, wind, precipitation and relative humidity. Each deserves to be included in overall land use planning, site planning and building design. Unfortunately, usable climatic data are still unavailable in most localities, the cost of obtaining base data is high and considerable lead time is required.

Large urban areas, such as the Toronto-Hamilton complex, metropolitan Montreal and greater Vancouver, have been shown to affect climate in a number of ways, some less desirable than others. Table 2.3 (adapted from Oke and others) indicates that the climate of cities can differ significantly from that of adjoining non-urban areas.

Table 2.3 Urban vs Rural Climate

Factor	Urban compared with rural (year-round average)
Air temperature	1°C higher
Relative humidity	6% lower
Rain	14% more
Snow	10% more or less
Thunderstorms	16% more
Wind speed	25% less (but more stagnant air)
Fog	60% more often
Visibility	25% poorer
Solar radiation	22% less
Pollution, by volume	10 times more

Large-scale urban development, it has been hypothesized: 1. makes a massive and concentrated heat input to the atmosphere; 2. radically alters the landscape, with tall buildings changing wind speeds and paved surfaces waterproofing the land; and 3. introduces large quantities of particulate matter and gaseous pollution to the air.



Measurements across an urban area are likely to reveal increasing temperatures toward its centre. The so-called *heat island* effect is probably caused by heat given off by buildings and vehicles combined with the heat-absorbing surfaces found in the built environment. Under calm conditions hot, dirty air rises over the urban area to form a kind of dome during the day. At night, some of the particulate matter falls back onto the urban area and some of it is dispersed across the adjoining countryside. At the same time the heat island effect creates its own wind system which draws pollutants back into the urban area from outside it. If rain or strong breezes do not occur soon enough to relieve the situation, air pollution concentrations build up.

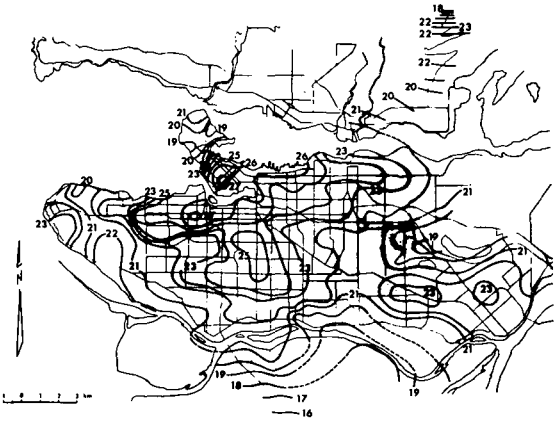


Figure 2.10 Heat Island (°C) in Vancouver, 4 July 1972, 2000 PST

Source: T.R. Oke, "The Significance of the Atmosphere in Planning Human Settlements", in E.B. Wiken and G.R. Ironside (eds.), *Ecological (Biophysical) Land Classification in Urban Areas. Proceedings of a Workshop, Canada Committee on Ecological (Biophysical) Land Classification, 23 & 24 November 1976, Toronto, Ontario* (Ottawa: Environment Canada, Lands Directorate, 1977).

Pollution build-up can be worsened considerably by the occurrence of a condition known as a *temperature inversion* where temperature increases, rather than decreases, with height. Coastal communities commonly experience inversions, especially in late winter, spring and early summer, due to cold water offshore and clear skies (Findlay). Breezes off a lake or ocean bring to the urban area cold, moist air which, under calm conditions, becomes trapped by the warm air above. Pollutants, smoke and other airborne substances which are unable to escape accumulate to form a visible hazy layer 50-1500 m above the ground. The highest air pollution levels are recorded when such conditions persist beyond 48 hours.

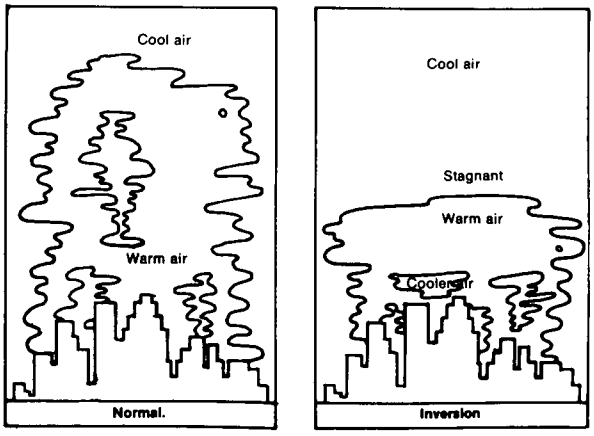


Figure 2.11 Temperature Inversion

When winds are brisk and steady, air pollutants tend to be transported from the urban area. Warmer air, conveying pollutants, may form a downwind *plume* which can travel long distances (recorded over 160 km) before dispersing to settle out its contents on the area below. Some evidence suggests (though this remains speculative) that certain pollutants can be *more* highly concentrated downwind in the plume than at their sources. Apparently it is possible for secondary pollutants to be formed by chemical reactions during downwind transport. If urban settlements and other major sources of air pollution are lined up along a strong long-distance prevailing wind (as in northeastern U.S.A.), their spacing might cause one plume to add to, perhaps even multiply, the air pollution effects of the next plume. A question of concern to planners, therefore, is: are any major developments with potential air pollution increases, proposed upwind, even though far away?

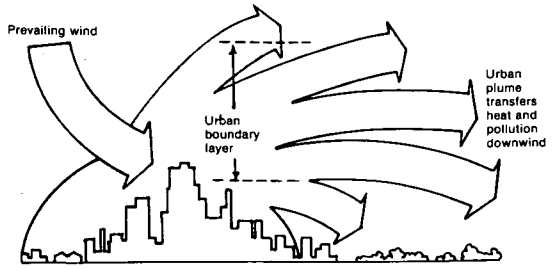


Figure 2.12 Urban "Plume" Effect

A given municipality may be able to favourably influence developments immediately upwind. Long-distance air pollution, however, like the SO_2 from St. Louis that ends up in Halifax, is a problem over which a local municipality has little or no control beyond pressuring provincial and federal governments. The more pollutants entering a community from outside, the less "allowable" pollution there can be from within its borders. The fact of outside air pollution, and the possibility of it getting worse, makes it important that each area (a) monitor its own air quality closely and regularly so that trends become apparent before they turn into major problems, and (b) use all available power and influence to minimize its own and its neighbours' air pollution.

At the planning stage, opportunities exist and are being increasingly exploited (see Case Study 4) to incorporate climatic data, first into the determination of the suitability of sites for various human activities, and then, into regional, local and site planning decisions. Stuttgart exemplifies what can be done when meteorologists interact effectively with land use planners and municipal decision-makers.

Case Study 9
Stuttgart's Air Quality Planning Program

Stuttgart, West Germany, is a city of 600 000 located in a highly industrialized area with serious air pollution problems. Thanks to a long-term program (begun in 1932) of incorporating meteorological data into urban planning and management, and despite unfavourable topography and concentrated development, the city's air quality is the best among cities of comparable size in West Germany. Established in 1951, Stuttgart's Chemical Investigation Office is coordinating the program and working closely with planners and enforcement agencies. A two-pronged approach is used:

1. Preventing pollutants from entering the air or reducing their intensity (for example, incinerators consolidated downwind, coal/oil burning prohibited in area where natural ventilation is insufficient, tall stacks, careful screening of new industries for air pollution potential, monitoring of air quality); and 2. Removing pollutants by moving more air through the city (careful attention to building form and texture to maximize air flow, reducing downward air flow by controlling building heights and location and by prohibiting development along certain natural

fresh-air channels, affecting upward air flow by reducing ground temperature and cooling the city through measures such as roof gardens and water accumulation on roofs as well as lawned parking lots and shaded asphalt areas, and accelerating horizontal air flow using wedge-shaped green areas pointing to the city centre and providing wide channels).

Though functioning as an advisor only, the Office seldom sees its recommendations disregarded. Credibility is enhanced by staffing the Office with climatologists who understand urban planning and have the data necessary to review and supplement plans and development proposals.

Contrast Denver, Colorado, described in an Case Study 65 (4.5 Transportation), and much closer to the typical North American city.

For further information on the Stuttgart program, see: G. Arno Loessner, "An Air Quality Planning Program with Visible Results", *Practicing Planner* (American Institute of Planners), March 1978, pp. 35-37. Stuttgart's approach is documented in a 20-minute colour film, "Urban Development and Urban Climate", prepared for the Habitat Conference and available on loan ($5.00 handling fee + mailing costs) from U.N. Audio-Visual Information Centre (2075 Westbrook Mall, Vancouver, B.C. V6T 1W5).

Case Study 10
Climatic Factors in Land/Soil Capability and Planning, B.C.
Submitted by Ray Crook, B.C. Environment and Land Use Committee Secretariat, and Klaus Ohlemann, B.C. Ministry of the Environment, Prince George.

Departments of the British Columbia government have begun to incorporate climatic suitability into overall land/soil capability analysis. Three examples are available from the Resource Analysis Branch, B.C. Ministry of the Environment (Parliament Buidings, Victoria V8V 1X4): B.C. Dept. of Agriculture, *Climate Capability Classification for Agriculture*, 1972; E.C. Bennett, *Climatic Suitability for Recreation in British Columbia*, 1977; and R.D. Wilson and R.D. Marsh, *Climatic Constraints to Logging and Climatic Suitability for Recreation in the Terrace-Hazelton Forest Resources Study Area*, 1975.

Climatic factors are also included in townsite planning and design associated with resource development. See: B.C. Ministry of Municipal Affairs and Housing. *Physical Plan — Tumbler Ridge, Northeast Sector, B.C.*, B.C. Ministry of Municipal Affairs and Housing (Parliament Buildings, Victoria V8W 3E1), 1978; and B.C. Ministry of the Environment, *Northeast Coal Study, Preliminary Feasibility Report on Townsite/Community Development*, available from the Environment and Land Use Subcommittee on Northeast Coal Development, E.L.U.C. Secretariat (Parliament Buildings, Victoria V8V 1X4).

British Columbia has begun to think in terms of mapping and predicting air pollution potential (Terrace-Hazelton Forest Resources Study). The Ministry of the Environment has used a method (taken from G.C. Holzworth, *Climatological Aspects of the Composition and Pollution of the Atmosphere*, World Meteorological Organization, Technical Note 139, 1974, p. 43) for classifying air pollution potential. However, vertical air profile data with which to apply any classification are seriously lacking at a local level of detail and often, indirect evidence (topography, vegetation) must be used.

Information Resources

See also:
2.2 Climate

Central Waterfront Planning Committee. *Climate Information Base.* Toronto: City of Toronto Planning Board (City Hall, Toronto M5H 2N2), Jan. 1976. $2.00.

Part of the Central Waterfront Information Base Study, an exercise undertaken by the Committee (comprising representatives from departments and agencies of the City of Toronto, Metropolitan Toronto and the Province of Ontario) to analyze, describe and present data on the existing environmental condition of the waterfront. This report overviews the waterfront climate, describes the various elements of climate (temperature, precipitation, humidity, visibility, wind, etc.), documents a bio-climatic analysis, discusses planning and design, and presents conclusions and recommendations especially with regard to land use planning.

Chandler, T.J. *Selected Bibliography on Urban Climate.* World Meteorological Organization (41 Ave. Guiseppe-Motta, 1211 Geneva, Switz.) 1970. 303 pp. Chandler, T.J. *Urban Climatology and its Relevance to Urban Design.* Geneva, Switzerland: World Meteorological Organization, 1976. 61 pp.

Findlay, B.C. "Meteorological Services for Ecological Land Classification", in Rubec, C.D.A. (ed.). *Application of Ecological (Biophysical) Land Classification in Canada.* Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1978. Free.

Reviews facilities offered by the national meteorological observation network. Describes recent climatological studies applied to recreation and tourism, agriculture, environment impact assessment and resource management in national parks. User problems in connection with these studies are attributed mainly to inadequate communication between client and contractor as to study purposes and content. See also Findlay, "Climatological Studies in Urban Areas" in Wiken and Ironside, below.

Fisheries and Environment Canada, Atmospheric Environment Service. *Energy and Climate: An Assessment of Relationships Between the Consumption and Production of Electricity in Ontario, and the Climate.* Royal Commission on Electric Power Planning (14 Carlton St., Toronto M5B 1K5), May 1977. 78 pp.

This submission to the Porter Commission describes for Ontario (a) the effects of climate and climate change on the requirements for electrical energy, (b) climate factors affecting energy production and transmission, and (c) impacts of energy production systems on climate.

Gates, A.D. *The Tourism an Outdoor Recreation Climate of the Maritime Provinces.* Environment Canada, Atmospheric Environment Services, Meteorological Applications Branch (4905 Dufferin St., Downsview, Ont. M3H 5T4), n.d. 133 pp. $4.00.

Promoting the use of meteorological data in recreation and tourism facility planning, this book examines the various aspects of climate, the winter and summer seasons, and the suitability of climate for various outdoor recreation and tourism activities. Useful information is presented on climate throughout the Maritimes.

Givoni, B. *Man, Climate and Architecture.* Second Edition. London: Applied Science Publishers, 1976. Hardcover, 483 pp. $40.00.

Hare, F. Kenneth and Thomas, Morley K. *Climate Canada.* Toronto: Wiley, 1974. Hardcover, 256 pp. $11.50.

Chapter 12 covers urban climates. Further references are provided. Annotated in 2.2 Climate.

Living Systems. *Indio, California, Energy Conservation Project. Final Draft Report.* Living Systems (Route 1, Box 170, Winters, CA 95694), 1977. 126 pp.

A study, commissioned by the U.S. Department of Housing and Urban Development and the City of Indio, to develop a local energy conservation program with active public involvement. A major component was a climate analysis and data collection system.

Lowry, W.P., "The Climate of Cities", Scientific American, 217, 1967, pp. 15-23.

Munn, R.T., "Industrial Development in the Lake Erie Region of Canada: Meteorological Assessment", paper presented at the International Symposium on Meteorological Aspects of Atmospheric Pollution, Leningrad, March 1977.

Dr. Munn is at the Institute of Environmental Studies, University of Toronto (Toronto M5S 1A4).

Oke, T.R., "The Significance of the Atmosphere in Planning Human Settlements" in E.B. Wiken and G. Ironside (eds.). *Ecological Land Classification in Canada. Proceedings of a Workshop, Canada Committee on Ecological (Biophysical Land Classification, 23 & 24 November 1976, Toronto, Ontario.* Ottawa: Environment Canada, 1977. Paperback, 167 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A OS9), $4.00.

Oke, a professor in the Department of Geography, University of British Columbia, describes the impact of climate on settlement and vice versa. Interaction between the atmosphere and the built environment is characterized by the feedback loop pictured above. Fundamental aspects of this interaction are reviewed and consideration is given to incorporation of this information into urban planning and design.

Olgyay, Victor. *Design with Climate: Bioclimatic Approach to Architectural Regionalism.* Princeton, NJ: Princeton University Press, 1963. Hardcover, $28.50.

Still the basic reference in its field. See also Givoni.

Page, J.K. *Application of Building Climatology to Problems of Housing and Building for Human Settlements.* World Meteorological Organization (41 Ave. Guiseppe-Motta, 1211 Geneva, Switz.), technical note 150, WMO No. 441, 1976. 64 pp.

United Nations, World Meteorological Organization. *Proceedings of the WMO Symposium on Meteorology as Related to Urban and Regional Land-Use Planning, Asheville, N.C., 3-7 November 1975.* WMO (41 Ave. Guiseppe-Motta, 1211 Geneva, Switz.), WMO No. 444, 1976. 298 pp.

U.S. Dept. of Agriculture, Forest Service. *Proceedings of the Conference on Metropolitan Physical Environment, Syracuse, N.Y., 25-29 August 1975.* U.S. Dept. of Agriculture, Forest Service (Northeastern Forest Experiment Station, Upper Darby, PA), 1977. 445 pp.

Proceedings of a joint meeting of mainly scientists and planners at which papers were presented on urban meteorology, acoustics, air quality, vegetation, human perception, planning and design. In particular, see J.P. McTaggart-Cowan and J.W.S. Young, "The Surface Air Temperature in a Maritime Metropolitan Region".

Microclimate

Local factors such as elevation, vegetative cover, exposure, and the presence of large water bodies can cause the climate specific to a site, (microclimate) to vary from the general climate of the larger area (mesoclimate or macroclimate). Microclimate refers to the scope of the area studied, not the size of the climatic differences, which may be considerable. In an urban area, for example, the temperature at ground level on a hot summer day may vary as much as 16°C from one place to another depending on such factors as vegetation, structures, surfaces, colours and textures, air pollution and the presence of sunlight or shade.

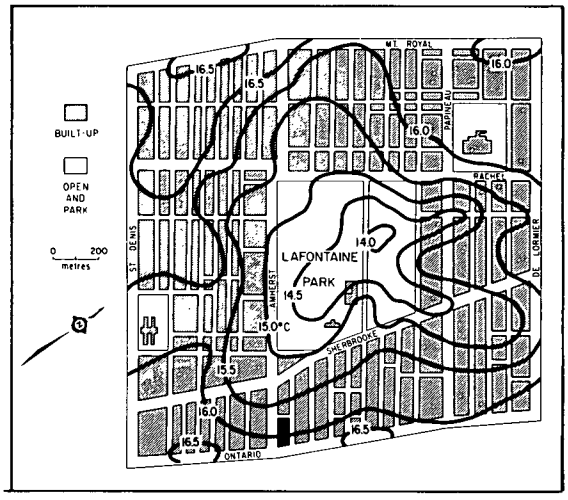


Figure 2.13 Temperature Distribution in the Vicinity of an Urban Park in Montreal

Source: T.R. Oke, "The Significance of the Atmosphere in Planning Human Settlements", in E.B. Wiken and G.R. Ironside, *Ecological (Biophysical) Land Classification in Urban Areas. Proceedings of a Workshop, Canada Committee on Ecological (Biophysical) Land Classification, 23 & 24 November 1976, Toronto, Ontario* (Ottawa: Environment Canada, Lands Directorate, 1977).

Topography is a major landscape determinant of microclimate. Water also has a warming and cooling effect, depending partly on the size of the water body. Orientation to the sun is important, as those who live on south-facing slopes know, as well as wind and the degree of shelter from it.

Unfortunately, microclimate data are not readily available. Judgements must be made by those knowledgeable about architectural design, building siting and landscape design and planting. Much can be done in the planning and design of the outdoor built environment, however, both to improve and detract from human comfort and livability. The mass, height, depth and length of a big building, for example, can dramatically affect wind speeds around it. We often curse Mother Nature for the howling winds in city centres when we should be blaming those who designed and built structures as well as those who sanctioned these projects.

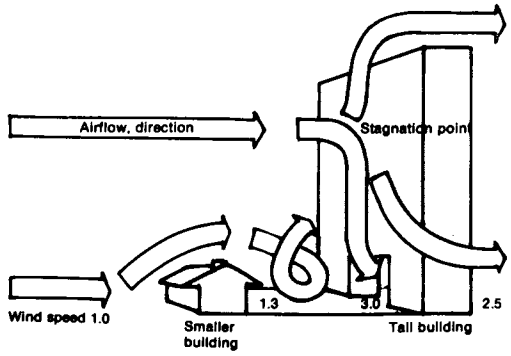


Figure 2.14 Wind and Buildings

Adapted from: T.R. Oke, "The Significance of the Atmosphere in Planning Human Settlements", in E.B. Wiken and G.R. Ironside (eds.), *Ecological (Biophysical) Land Classification in Urban Areas, Proceedings of a Workshop, Canada Committee on Ecological (Biophysical) Land Classification, 23 & 24 November 1976, Toronto, Ontario* (Ottawa: Environment Canada, Lands Directorate, 1977).

Modelling techniques for use in planning to accommodate microclimate conditions have advanced significantly in recent years. For example, during planning for the central waterfront in Toronto, the Ontario Ministry of the Environment modelled wind and air quality to test building height and configurations; planners of Harbour Square Park similarly used wind modelling (water flume) to test different park design alternatives aimed at minimizing winds affecting park users and vegetation. At the University of Guelph, Frank Theakson has modelled snow conditions at the microclimatic scale, enabling prediction of wind and snow conditions surrounding buildings and landscape elements. Another example is a wind tunnel study conducted by the University of Alberta and commissioned by Syncrude Ltd., to examine effects of a proposed tailing dyke (60 m above ground level) on air quality in the immediate plant environs; the analysis identified a potentially hazardous build-up of ground/low level SO_2 sources which would affect the final dyke configuration. Such studies assist planners to anticipate, avoid or mitigate problems which are beyond easy solution after construction is completed.

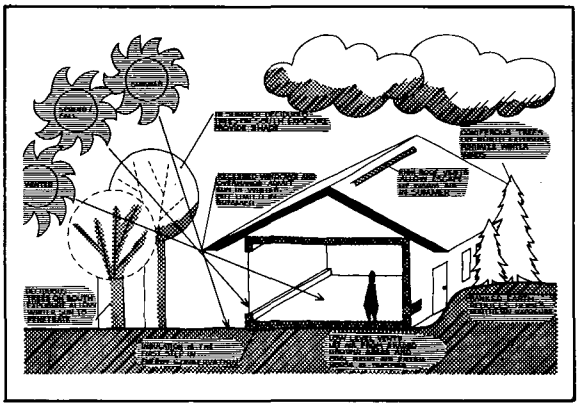


Figure 2.15 A Passive Solar System

Source: Ontario Ministry of Energy, *Turn on the Sun* (Toronto: The Ministry, 1978).

Microclimate considerations are especially significant in energy conservation. Taking into account solar geometry in the design and layout of a house, for example, makes it possible to provide shade in the summer months when the sun is high in the sky, and sunlight in the winter when the sun is lower. Careful use of deciduous trees can provide shade without interfering with solar radiation in the colder seasons when leaves have fallen. Communities such as the City of Davis, California, have translated these well-known but seldom acted-upon facts into planning, design and development control measures designed to facilitate the use of solar energy and increase livability in the human environment.



Information Resources

See also:
2.2 Climate and Human Settlement
2.7 Energy

Brainerd, John. *Working With Nature: A Practical Guide.* New York: Oxford University Press, 1973. Hardcover, 517 pp. $17.50.

Practical examples of how to create and maintain favourable microclimatic conditions beneficial to both human and nonhuman life.

Florida Dept. of Administration, State Energy Office. *A Planner's Handbook of Energy (with Emphasis on Residential Uses).* Florida Dept. of Administration, State Energy Office (108 Collins Building, Tallahassee, Fla. 32304), Nov. 1975. 270 pp. $4.50 (cheque payable to State of Florida, Dept. of Administration).

Chapter 2, "Preliminary Considerations Affecting Energy Consumption in a Single Family Dwelling", covers microclimate considerations in some detail.

Laurie, Michael. *An Introduction to Landscape Architecture.* New York: American Elsevier Publishing Co., 1975. Hardcover, 214 pp. $25.00. Microclimate is covered on pages 169-176.

McGregor, G.S., "Davis, California, Implements Energy Building Code", *Practicing Planner* (American Institute of Planners), Feb. 1976.

The City of Davis (population 30 000, located just outside Sacramento) has available several publications describing its programs: *A Strategy for Energy Conservation,* $5.00; *Davis Energy Conservation Ordinance,* $3.00; and "Energy Conservation News", a newsletter. Order from Living Systems (Route 1, Box 170, Winters, CA 95694). Also contact Gloria McGregor, Director, Community Development Dept., City of Davis (226 F St., Davis, CA 95616).

National Association of Home Builders. *Cost Effective Site Planning, Single Family Development.* NAHB (15th and M St., NW, Washington, DC 20005), 1976. Paperback, 143 pp. $12.50.

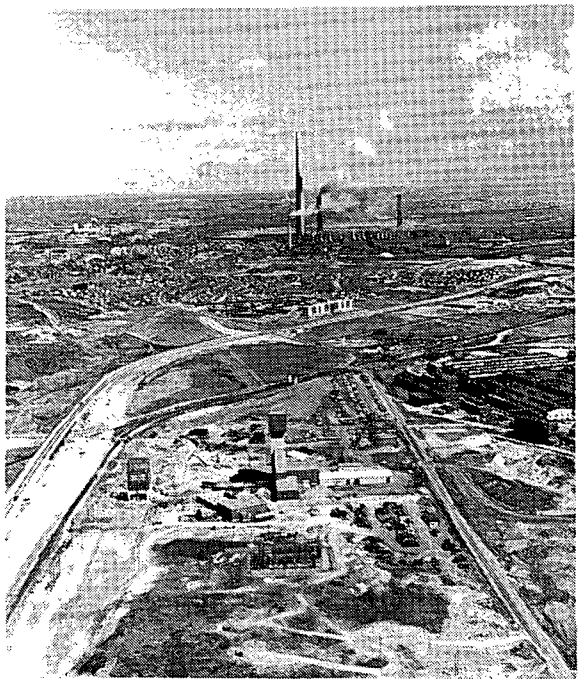
Chapter II.D, "Energy Conservation Considerations", discusses building siting and orientation to facilitate energy conservation under various sets of climate conditions. Measures are proposed to maximize the warming effects of solar radiation (e.g., use south/southeast-facing slopes, create protected sun pockets, use darker colours, use exterior walls and fences to capture winter sun and reflect warmth into living zones) and to reduce the impact of cold winter winds (locate buildings on lee side of hills in wind shadows; use evergreens, berms and walls to protect northern exposure; use flat or shallow-pitched roofs to collect and hold snow for added insulation; build into the ground). Tips for climate modification are offered – to make it warmer or cooler, breezier or less windy, and drier or more humid.

Robinette, Gary O. *Plants/People/and Environmental Quality.* Washington, DC: U.S. Dept. of the Interior, 1972. Paperback, 139 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $4.00 + 25% outside U.S.A..

The "climatological uses of plants" such as solar radiation control, wind control, precipitation control and temperature control are discussed in detail and attractively illustrated on pages 67-101.

Air Quality

Clean fresh air is a mixture of water vapour and gases (about 78% nitrogen and 21% oxygen plus small quantities of carbon dioxide, argon and several other gases) with tiny suspended particles like droplets of water and snow, salt crystals, pollen, etc. Man's activities have changed the composition of the air, especially in urban and industrial areas, by altering the concentrations of "natural" gases and introducing new substances. Often the result is what we know as air pollution. Though hardly a new problem – references to it emerged in the early Middle Ages when coal began to be substituted for wood – air pollution in recent years has reached worldwide proportions. Improvements have occurred since the first major "incidents": Meuse Valley, Belgium, 1930; Donora, Pennsylvania, 1948; and the London smog of 1952 which contributed to 4,000 additional deaths in a week. Smoke and soot control have dramatically reduced these emissions. Significant gains have also been made in controlling sulfur oxides. But national statistics can obscure deteriorating conditions and pollution episodes continue to occur. New pollutants such as PCBs are being discovered. Respiratory diseases, whose severity is intensified by air pollution, are on the increase. And a return to coal-burning in the near future could raise serious new health challenges. Attention is also shifting to the long-term effects on man, other living things and total ecological systems. Air pollution, therefore, continues to be a major issue, highly visible and often the focus of public concern.



Air pollution has been defined for legal purposes, as the presence in the outdoor atmosphere of one or more air contaminants in such quantity and duration and under such conditions that may cause discomfort to or endanger the health, safety and welfare of people, or that may cause injury or damage to plant or animal life or property, or that interferes unreasonably with the normal enjoyment of life or use of property or conduct of business (Winthrop). Table 2.4 summarizes the sources and effects of the five most common air pollutants in Canada. Missing from the chart are several that are also significant. *Photo-chemical oxidants* are the chemical compounds (chiefly ozone, which can adversely affect crops, and PAN) that form the main components of smog which may result when hydrocarbons and nitrogen oxides are exposed to sunlight. *Heavy metals* such as lead, cadmium, mercury and arsenic have recently caused concern. *Fluorides* especially contaminate plants while fluorocarbons as propellants (aerosol cans) pose a long-term threat to the protective ozone layer in the atmosphere. *Pesticides,* long the target of environmentalists, recently came under close scrutiny in Atlantic Canada and British Columbia when a link was suggested between the disease Reye's Syndrome and the emulsifier used in the spray against the spruce budworm. Finally, *odorous compounds,* such as hydrogen sulfide, create considerable nuisance problems in populated areas.

The main source of air pollution is the combustion of fossil fuels, especially by automobiles and power plants. Introduction of the coal-fired generating station at Nanticoke in southwestern Ontario, for example, resulted in farmers having to move from the area because of the sensitivity of their crop, white beans, to SO_2. Other notable sources include iron and steel manufacturing (Hamilton and Industrial Cape Breton are prominent examples), metal smelting (e.g., the Noranda smelter in Quebec), oil refining (numerous locations), natural gas production (which in the Peace River region, for example, combines with the presence of acidic soil to adversely affect agricultural productivity as well as posing a health hazard), pulp and paper manufacture (the Dryden Mill of Reed Paper, with its massive discharges of mercury and suspected consequent effects on the health of Indians who eat the fish), and chemical and petrochemical operations (Sarnia).

Table 2.4 Principal Air Pollutants

Pollutant	Major Sources	Effects
Carbon monoxide Colourless, odourless, tasteless gas, about 97% as heavy as air.	Gasoline-powered motor vehicles (about ⅔ of total emissions). Also industrial (e.g. petroleum refining) and burning.	*Humans:* CO entering bloodstream interferes with ability of blood to transport oxygen, impairing nervous system. At high concentrations, kills quickly. Concentration of 100 ppm, possible in heavy traffic, can cause dizziness, headache, lassitude, other symptoms of poisoning; can be a traffic hazard. 30 ppm for 8 hours or 120 ppm for 1 hour can be serious health risk to sensitive people (with heart disease, asthma, for example).
Sulfur oxides Chemical compounds of sulfur and oxygen, principally: *Sulfur dioxide* (SO_2). Colourless gas with pungent, irritating odour at concentrations of above 3 ppm. *Sulfur trioxide* (SO_2). Gas, which combines with water in the atmosphere to form sulphuric acid.	Burning of sulfur-bearing fuels, such as coal and oil, for space heating and power generation. Also, industrial processes, especially petroleum refining and non-ferrous smelters.	*Humans:* SO_2 alone can irritate upper respiratory tract. If absorbed on particulate matter or converted into H_2SO_4, can be carried deep into the lungs where it can injure delicate tissue. Prolonged exposure to low levels of SO_2 has been associated with increased deaths due to cardiovascular disease in older persons. Higher levels may produce increased deaths due respiratory diseases and children complaining of cough, mucous membrane irritation. *Plants:* Sulfur oxides damage trees and other plants especially grains, alfalfa, grapes, white pine, apples. *Other:* Also attack and destroy building materials including steel, zinc, paints, nylon and stone. High concentrations coupled with high humidity reduce visibility and create sulfuric acid.
Nitrogen oxides Compounds of nitrogen and oxygen, principally: *Nitric oxide* (NO) Colourless gas. relatively harmless but convertible to: *Nitrogen dioxide* (NO_2) Gas, normally brownish-red in colour. In presence of sunshine, can act as a trigger for photochemical reactions resulting in smog.	Fuel combustion. About half from transportation fuels, particularly automobile gasoline. Also, burning of fossil fuels for space heating and electric power generation.	*Humans:* Poorly understood. 13 ppm may cause eye and nose irritation. Higher concentrations indicate lung damage in animals. *Plants:* Nitrogen oxides restrict plant growth; injuries similar to SO_2.
Hydrocarbons Compounds of hydrogen and carbon. Major pollutants result from incomplete combustion of fuels and evaporation of fuels and industrial solvents. Exist in air primarily as gases (methane, ethylene, acetylene, etc.). Benzo-a-pyrene is a solid particulate.	Most (approximately 85%) emitted from natural sources (vegetation, bacterial decomposition of organic matter). Major man-made source is processing, marketing and use of petroleum. Vehicle exhausts are prime sources; also waste incineration. Benzo-a-pyrene is found in tobacco smoke.	*Humans:* Most hydrocarbons toxic only at high concentrations. Some, including benzo-a-pyrene have produced cancer in animals (one study found that breathing city air is equivalent to smoking 7 to 36 cigarettes per day). Even low concentrations and certain hydrocarbons react with sunshine to produce smog.
Particulates Any matter, liquid or solid, dispersed in the air with individual particles smaller than 500 microns (about 1/50 of an inch) in diameter. May remain airborne from a few seconds to months. Includes aerosols, visible particles, fumes, soot.	Plants generating electricity power. Industries. Fires. Automobile exhaust (particles include lead); diesel vehicles are particular offenders (10 times as much particulate matter per gallon as gasoline-powered vehicles).	*Humans:* Some particulates are potentially poisonous or disease-producing (e.g., arsenic, asbestos, fluorides, lead). Others multiply potential harm of irritant gases (e.g., SO_2 absorbed on particulate matter will penetrate deeper into the lungs and damage tissue). Still others speed chemical reactions in the atmosphere, producing much more harmful substances (e.g. acid rain).

Source: adapted from Brian J.L. Berry and Frank E. Horton, *Urban Environmental Management: Planning for Pollution Control* (Englewood Cliffs, NJ: Prentice-Hall, 1974).

Air pollution affects man and his environment in various ways: as a hazard to human health; as a threat to vegetation; by altering climatic conditions especially through particles acting as nuclei around which raindrops form, but also by interfering with sunlight; by damaging man-made materials and property; by creating hazards, poor visibility in particular; by generating additional costs to repair resulting damage and to prevent adverse effects; and by diminishing aesthetic, recreational and other environmental amenities.

Air quality varies considerably across Canada. Local pollution sources account for only part of the difference. Climatic conditions, which can concentrate or disperse pollutants in the atmosphere, are also a factor. Long-distance transport of air pollutants has recently emerged as a problem of major proportions, especially in Eastern Canada which lies downwind from the big urban-industrial concentrations of the United States.

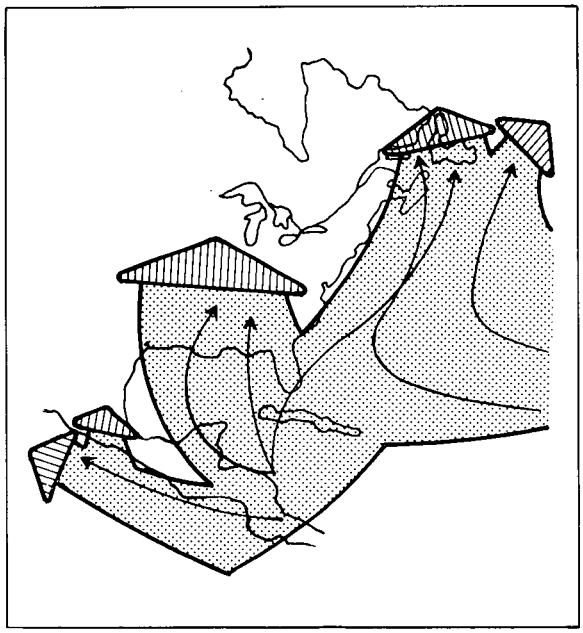


Figure 2.16 Predominant Paths of Storm Centres Affecting Eastern North America

Source: Reg Lang and Audrey Armour, *Oakville Environmental Report: A Case Study in Environmental Planning* (Toronto: Lang Armour Associates, 1977). Reproduced with permission.

Measures such as the building of tall stacks to disperse pollutants away from the local area can contribute to long-distance air pollution if they enter one of the higher-level fast-moving air streams. *Acid rain* is an example, caused when sulfur dioxide is oxidized in the atmosphere to sulfur trioxide which combines with water vapour and particulates to form sulfuric acid and sulfates; it can end up many miles sometimes continents away from the industrial area where the gases originated. In places such as north-central Ontario (Sudbury is the site of the world's largest single point source of sulfur dioxide), upper New York and the Scandinavian countries, acid rain has destroyed virtually all aquatic life in some lakes and acidity levels in others are steadily increasing.

Concentration of pollutants in the air depends both on the height and rate of emission and the ventilation available. Lake-fronting communities, for example, should do everything possible to maintain the air flow, especially the natural land-water breezes (which also modify the local climate). Pollutants also vary according to the form and pattern of a given urban area, its industry mix and the extent of emission control exercised. Opportunities exist through local and regional planning, therefore, to introduce air quality considerations into local and regional planning and decision-making processes.

One problem is the absence of comprehensive data on air quality, now and in the future, and the difficulty of measuring it because the instrumentation is costly or unavailable. A few of the larger Canadian centres measure the main pollutants – principally SO_2 and suspended particulate matter and sometimes CO, hydrocarbons and nitrogen oxides – but only at a few stations. That overlooks a lot of pollutants, provides only partial coverage and gives no data whatsoever for smaller centres and rural areas. Another problem is the discrepancy in the criteria used to judge the seriousness of each pollutant. For example, for suspended particulates the concern is with total weight of airborne particulate matter, a crude measure that fails to distinguish tiny particles which can penetrate the lungs from larger ones which cannot. Further, the standards themselves are open to question. The relationship between a particular level of pollutant and a given effect is often tenuous, making the standard arbitrary and opening up the possibility of defining away the problem by raising the standard, a practice that has been suggested

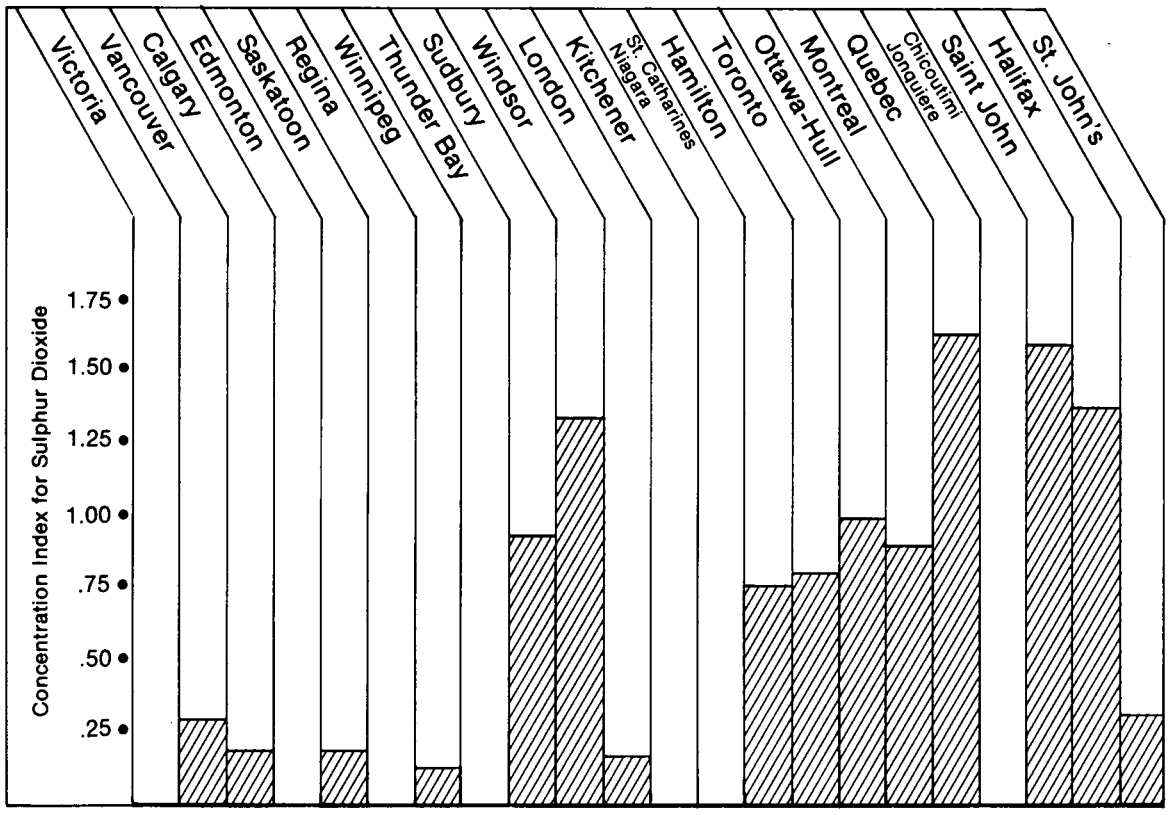


Figure 2.17 Air Quality Indicators (Sulfur Dioxide Concentration) for Various Canadian Centres

Source: Ministry of State for Urban Affairs, *Urban Indicators: Quality of Life Comparisons for Canadian Cities* (Ottawa: MSUA, 1976).

in connection with mercury pollution, although in most cases the standards, based on best-available knowledge, tend to be conservative.

Table 2.5 Air Quality Standards Under the Clean Air Act, 1978

Pollutant	Upper Range of Tolerable Level
Particulate matter	400 micrograms/cu. metre (24-hour average)
Sulfur dioxide	800 micrograms/cu. metre (24-hour average)
Carbon monoxide	20 micrograms/cu. metre (8-hour average)
Nitrogen dioxide	300 micrograms/cu. metre (24-hour average)
	1 000 micrograms/cu. metre (1-hour average)
Oxidants	300 micrograms/cu. metre (1-hour average)

All of the foregoing refers primarily to the outdoor environment. Yet it is the *indoor* environment which most of us experience for the greater part of our lives. Air quality here is equally vital. Some attention has been directed to the workplace, especially for industries such as uranium mining and processing, production of iron and steel, more recently industries extracting or processing asbestos, and the manufacture of hazardous chemicals. Office environments have only begun to receive attention, mainly with respect to the quality of recycled air in air-conditioned buildings and the possible detrimental effects of fluorescent lighting. On another front, tobacco smoke has become a popular issue; organizations such as the Non-Smokers Rights Association, created to battle for smoke-free public areas, argue that "involuntary smoking" represents a major health hazard and an infringement on the right to clean air. Cities such as Toronto have enacted bylaws to prohibit or limit smoking in certain public places.

Such problems, however difficult, lie within our capability to solve them. For other air quality problems such as acid rain, real solutions will strike deep at an urban-industrial society (politics, economics, energy, lifestyle) and severely challenge its ability to adapt. As Hall states, "The formidable task now at hand is to strike the crucial but delicate balance between changing the conditions that have created the acid rain dilemma and adapting to those conditions".

Case Study 11
Acid Rain in South-Central Ontario

A recent study by the Ontario Ministry of the Environment found the precipitation in this part of Canada to have a mean pH between 3.95 and 4.38 with frequent "events" over 4.0 (neutral water has a pH of 7.0; water with a pH of less than 5.5 will cause death of some fish species). South-central Ontario's precipitation is more acidic than in the Sudbury region (where various lakes are already "dead") or Scandinavia, and as acidic as in north eastern United States (where it presents a major problem for aquatic life, crops and property). A major component of total acidity is strong mineral acid. The report is careful to say that the source is uncertain but "contributions from smelting operations to the N and NW and large urban areas to the SE-SW are probable". Because most lakes in south-central Ontario have low buffering capacity, high acid loadings are likely to tend to acidification in the foreseeable future. The report concludes:

> *The potential effects of acidic precipitation in Ontario are extremely serious; both aquatic and terrestrial damage have been documented in other parts of the world. Because a large portion of Ontario is underlain by Precambian rock, the region that can possibly be affected is large. There is no doubt that should current acid loadings continue in south-central Ontario, the acidification of a large number of lakes and streams will follow.*

See: P.J. Dillon et al., *Acidic Precipitation in South-Central Ontario: Recent Observations* (Ontario Ministry of the Environment, Box 213, Rexdale, Ont.), Sept. 1977.

See: Ross Howard, "Inco Fumes are Tracked to Toronto", *Toronto Star,* 12 August 1978.

Information Resources

See also:
2.2 Climate and Human Settlement
2.5 Vegetation
4.5 Transportation

Bates, David V. *A Citizen's Guide to Air Pollution.* Montreal: McGill-Queen's University Press, 1972. Paperback, $3.25.

Volume 2 in the series "Environmental Damage and Control in Canada", sponsored by the Canadian Society of Zoologists. A concise statement of the nature of air pollution problems with Canadian examples.

Berry, Brian J.L. and Horton, Frank, E. *Urban Environmental Management: Planning for Pollution Control.* Englewood Cliffs, NJ: Prentice-Hall, 1974. Hardcover, 425 pp. $14.95.

Chapter 4, pages 81-123, covers the nature of air pollution: sources of the key pollutants, the meteorology of air pollution, surveillance systems and perception of air pollution. Chapter 5, pages 124-166, discusses air pollution control in the United States and economic analysis for effective air-resource planning, especially the use of cost/benefit analysis and the assessment of air pollution effects.

Berry, Brian J.L. et al. *Land Use, Urban Form and Environmental Quality.* University of Chicago, Dept. of Geography (5228 S. University Ave., Chicago IL 60637), Research Paper No. 155, 1974. Paperback, 440 pp. $5.00.

Air quality (including pesticides, noise and radiation) is extensively covered in this study of the ways in which urban form and land use affect the nature and intensity of environmental pollution, both inter- and intra-regionally. A key point made is that a critical need exists to understand the processes that give all complex systems order, not merely to observe and attack symptoms such as air pollution. Annotated further in 4.2 Urbanization.

Bower, Blair T. and Sewell, W.R. Derrick. *Selecting Strategies for Air-Quality Management.* Ottawa: Dept. of Energy, Mines and Resources, 1971. 47 pp. Available from Supply and Services Canada, Printing and Publishing (Ottawa K1A 0S9. $1.50.

British Columbia. Ministry of the Environment, Water Investigations Branch. *Kootenay Air and Water Quality Study. Phase II: Air Quality in the Elkford-Sparwood-Fernie Region.* The Ministry (Parliament Buildings, Victoria V8V 1X4), April 1978. 93 pp.

Annotated in 4.4 Resource Development.

Central Waterfront Planning Committee. *Air Quality Information Base.* City of Toronto Planning Board (City Hall, Toronto M5H 2N2), 1976. $2.00.

Part of a series of reports prepared during planning for the waterfront.

Chanasyk, Victor. *The Haldimand-Norfolk Environmental Appraisal. Volume 1: Inventory and Analysis.* Toronto: Ont. Ministry of Treasury, Economics and Intergovernmental Affairs, 1970. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1NB), $10.00 (Vols. 1 and 2), cheque payable to Treasurer of Ontario.

The Ontario Government commissioned this comprehensive appraisal of the natural, recreational, landscape, agricultural and scenic resources of a 2,000 square mile (5 180 km^2) area planned for major industrial (steel mill) development. Appendix 2 "Meteorology and Air Pollution Climatology", relates these two factors for the area in question and examines the relevance of various regional air pollution simulation models.

Environment Canada, Environmental Protection Service, Air Pollution Control Directorate. *An Annotated Bibliography of Canadian Air Pollution Literature: Supplement.* The Directorate (Ottawa K1A 1C8), Report En 42-3/77-1, 1978. 69 pp. Free.

An annotated and categorized listing of litterature published since mid-1973, supplementing Report EPS-3-AP-75-2.

Forrest, Anne, "Breathing Can Be Injurious to Your Health", *Alternatives,* Vol. 6, No. 3, Spring 1977, pp. 14-17.

Reports on air pollution and cancer deaths in the Hamilton, Ontario area. Similar articles in this journal include: Femida Handy, "Air Quality and Income in Hamilton, Ontario", Spring 1977; and J.R. Kraner, "Atmospheric Composition and Precipitation of the Sudbury Region", Spring 1973.

Grandjean, E. and Gilgen, A. *Environmental Factors in Urban Planning.* London: Taylor & Francis Ltd., 1976. Hardcover, 106 pp. $24.50.

Part 1, pp. 3-60, covers air pollution (sources, extent, effects of weather conditions, effects on human health, measurement and abatement). Part 2, pp. 71-127, deals with noise (nature, effects on people, road noise and aircraft noise). The rest of the book is on urban open spaces and on sunlight and natural lighting indoors.

Hagevik, George, Mandelker, D. and Brail, R. *The Contribution of Urban Planning to Air Quality.* Washington, DC: U.S. Environmental Protection Agency, 1974. 477 pp. Available from National Technical Information Service (5285 Port Royal Road, Springfield, VA 22161).

Probably the most extensive source currently available on the relationship of air quality to urban land use planning. First, the Clean Air Act of 1970 is analyzed as it relates to land use controls. Then the problems relating land use planning and air quality at the state level are defined with special attention to Vermont and Maine, leaders in this regard. Administrative review procedures (including environmental assessment) for relating land use planning to air quality management are examined next. Buffer zones are studied as are air pollution control techniques. Selected local controls, especially performance standards, zoning and building design, receive similar attention. Methods of estimating emissions from land use categories are reviewed. The remaining chapters discuss the dispersion of pollutants by meteorological influences, air quality management in California, and "non-degradation" (a policy providing that air quality in certain parts of the country, if higher than federal standards, should not be allowed to deteriorate significantly). Recommendations are presented for both the land use planner and the air pollution control official.

Hagevik, G., Mandelker, D.R. and Brail, R.K. *Air Quality Management and Land Use Planning: Legal, Administrative and Methodological Perspectives.* New York: Praeger, 1974. Hardcover, 336 pp. $20.00.

Hall, Robert F., "Acid Rain Dilemma Sparks Broader Issues", *New York State Environment,* Vol. 7, No. 11, June 1978 (monthly; $2.50 a year from N.Y.S. Environment, P.O. Box 905, Latham, NY 12110).

An updating of an early extensive article (*N.Y.S. Environment,* July 1975) describing the results of the 12 year study on acid rain. Sudbury is a key source of the New York problem where more than half of the lakes in the Adirondacks above 600 m have become highly acidic, 90% of them to the point where they are devoid of fish. The author points out (from Toffler) that while only in the last two lifetimes has anyone anywhere used an electric motor, ours is the lifetime that first saw lakes without fish.

Henderson, John J. et al. *Indoor-Outdoor Air Pollution Relationships. Volume 11, An Annotated Bibliography.* U.S. Environmental Protection Agency (Office of Research and Development, National Environmental Research Centre, Research Triangle Park, NC 27711), 1973. 42 pp.

107 sources on an air-quality relationship often ignored.

Indorair. Quarterly newsletter of the Non-Smokers Rights Association (Suite 404, 455 Spadina Ave., Toronto M5S 2G8). $1.00 per copy or available with membership in the NSRA.

Comparable organizations exist elsewhere in Canada. See also: Dept. of National Health and Welfare, Long Range Health Planning Branch and Non-Medical Use of Drugs Directorate, *Smoking and Health in Canada* (Health and Welfare Canada, Ottawa K1A 0K9), March 1977, 166 pp. Free.

Keyes, Dale L. *Land Development and the Natural Environment: Estimating Impacts.* The Urban Institute (2100 M St., NW, Washington, DC 20037), 1976. 128 pp. $4.95.

Air quality is discussed in Part 1, pages 7-47, including adverse effects of air pollution, principles of emission and atmospheric dispersion, air quality impacts of land development, measures and standards of air quality, measurement and estimation procedures, and conclusions relevant to the planner.

Keyes, Dale L. *Metropolitan Development and Air Quality.* The Urban Institute (2100 M St., NW, Washington, DC 20037), April 1977. 102 pp. Not for general circulation.

This study investigates the relationships between metropolitan form (the spatial arrangement of urban activities) and air quality with particular reference to sulfur dioxide, particulates, carbon monoxide and photochemical oxidants. It concludes that no broad generalization on these relationships is justified; reference must be made to individual pollutants. Sulfur dioxide and particulates are less a function of land use arrangements than of industry characteristics; metropolitan patterns, however, do affect the distance between point sources and exposed population. Carbon monoxide, though largely a mobile source, is simlarly influenced by metropolitan patterns through the spatial distribution of trip origins and destinations. On the other hand, photochemical oxidants and nitrogen dioxide which result from complex chains of chemical reactions, cannot yet be related to urban patterns. Opportunities do exist to influence air pollution (SO_2, particulates, CO) in both the planning and regulatory aspects of urban management. The author argues that land use controls should be a supplement to the direct regulation of emissions from point sources. He identifies tradeoffs between air pollution and density (e.g., with respect to CO, lower densities produce greater distances between sources and receptors but create higher emission levels due to increased travel) and discusses the social implications of air pollution (who benefits/pays).

Kitzweg, Jerry A., "Urban Planning and Air Pollution Control", *Journal of the American Institute of Planners,* Vol. 39, No. 2, March 1973, pp. 82-92.

Rigorous attempts to include air pollution considerations in urban planning, or to indicate land use policies or controls in programs for achieving air-quality standards, are rare and recent. This article reviews U.S. federal legislative attempts to introduce air pollution into urban planning, then describes five research projects aimed at delineating the interrelationships between air quality and the intensity and spatial distribution of human activity at urban and metropolitan scales. Proposals examined include zoning to limit emission density, a mathematical dispersion model to estimate CO, forecasting air pollution potentials of alternative plans and evaluating their desirability, effect of roadway configurations on an air pollution concentrations, and effect of building design on indoor air quality.

Lave, L. and E. Seshkin, "Air Pollution and Human Health", *Science* 169, 21 August 1970, pp. 723-733.

Liptak, B.G. (ed.). *Environmental Engineers Handbook. Volume 2: Air Pollution.* Radner, PA: Chulton Book Co., 1974. Hardcover, $35.00.

"Long-Range Transport of Atmospheric Pollutants". *Forestry Resource Newsletter,* Autumn, 1977 (Great Lakes Forest Resource Centre, P.O. Box 490, Sault Ste. Marie, Ont. P6A 5M7), and G.A. McBean, *The Long-Range Transport of A Pollutants Program,* paper presented to Western and Northern Regional Board, Saskatoon, May 1977. Environment Canada, LRTAP Program, Ottawa K1A 0H3).

Environment Canada is conducting a major study of the transport of air pollutants over hundreds to thousands of kilometres. Of particular concern are acid rain leading to increased acidity of lakes and consequent decline of fish stocks (e.g., the pH of George Lake in the La Cloche Mountains near Georgian Bay has changed from 6+ in 1961 to less than 5 in 1973 causing elimination of some fish species and drastic effects on others) and the concentration of particulate sulfate.

Main sources of atmospheric sulfates are primary smelters and natural gas processing plants. The study involved four working groups: emission/control/abatement, atmospheric transport, aquatic effects, and terrestrial effects. G.A. McBean (Environment Canada) is Chairman of the LRTAP Scientific Committee.

Loughlin, F.S. *The Clean Air Act — Compilation of Regulations and Guidelines.* Environment Canada, Environmental Protection Service (Ottawa K1A 1C8), Nov. 1977. 68 pp. Free.

Includes ambient air quality objectives and regulations (sulfur dioxide, suspended particulate, carbon monoxide, oxidants, nitrogen dioxide, lead-free and leaded gasoline, lead, arsenic, asbestos, mercury and chemical composition of fuels), asbestos, mercury and guidelines (cement, asphalt paving, metallurgical and arctic mining industries) under the Act.

National Research Council of Canada, Associate Committee on Scientific Criteria for Environmental Quality (Ottawa K1A 0R6). Various publications on air pollutants.

Nicholl, C.S. and Choquette, P.J. *Ambient Air Quality 1970-74: A Statistical Analysis.* Fisheries and Environment Canada, Air Pollution Control Directorate (Ottawa K1A 0H3), Feb. 1977. 69 pp.

Found that air pollution levels (for the pollutants measured) generally decreased across Canada between 1970 and 1974. Most of the decrease for SO_2 and CO, however, occurred in the 1970-73 period, with a levelling off shown in 1973-74. Recent Ontario studies show similar results, with the leveling off period continuing to the present. Significant regional variations exist across Canada.

Real Estate Research Corporation. *The Costs of Sprawl: Environmental and Economic Costs of Alternative Residential Development Patterns at the Urban Fringe. Detailed Cost Analysis.* U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), 1974. Paperback, 278 pp. Catalogue No. PREX 14.2:SP7/2, $3.45 + 25% outside U.S.A.

Chapter V.D includes air pollution. Compares levels of emissions (of particulates, sulfur and nitrogen oxides, carbon monoxide, hydrocarbons) resulting from natural gas use in five different neighbourhood layouts (single family, clustered, townhouse, walk-up apartments, high-rise apartments, and residential mix).

Rydell, Peter and Schwartz. 'Air Pollution and Urban Form: A Review of Current Literature', *Journal of the American Institute of Planners,* March 1968.

Soyka, Fred with Edmonds, Alan. *The Ion Effect: How Electricity Rules Your Life and Health.* Lester and Orpen Ltd. (42 Charles St. E., Toronto M4Y 1T4), 1977. Hardcover, 181 pp. $7.95.

A Canadian businessman/engineer and a journalist raise controversial questions concerning the effect of negative and positive ions in the air. They claim that excessive positive ions which often accompany weather disturbances, create disturbances, create feelings of anxiety in sensitive people and can induce heat attacks, migraine headaches, allergies, arthritis and other ill effects. Since city air and most central-heated air conditioned environments contain too few negative ions, most of us are exposed often to "pos-ion poisoning". The book suggest some remedies.

Sparrow, C.J. and Foster, L. *An Annotated Bibliography of Canadian Air Pollution Literature.* Environment Canada, Environmental Protection Service, Air Pollution Control Directorate (Ottawa K1A 1C8), April 1975. Free.

State of California, Air Resources Board. *Air Quality — Land Use Considerations in Ongoing State Planning Process.* The Board (1709 Eleventh St., Sacramento, CA), Sept. 1974. 10 pp.

Surveyed various state agencies to find out how their programs related to the State's goals for clean air, and how their planning processes related to planning for air quality. A lack of adequate air quality consideration in several agencies and absence of necessary expertise in most was found. Environmental impact review processes, which have introduced air quality concerns in planning processes, are often too late; earlier consideration is required. Interagency coordination is a prime problem.

Tollan, H. (ed). *Annotated Bibliography 1974-77, SNSF Project — Acid Precipitation: Effects on Forest and Fish.* SNSF Project (Box 6, 1432 AAS — NLH, Norway), 1978.

Full coverage of Norwegian studies on acid rain.

Van Nest, William J. and Hagevik, George H. *Air Pollution and Urban Planning: A Selective Annotated Bibliography.* Council of Planning Librarians (P.O. Box 229, Monticello, IL 62856), Exchange Bibliography #257, 1972. 64 pp. $6.50.

Winthrop, S.O. *Air Pollution in the Urban Environment.* Ottawa, Ont.: Environment Canada, 1973 (published 1976). 11 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $0.75.

A concise review of the nature of the problem, main sources of air pollution, its effects present control methods, economic considerations and future prospects.

Young, J.W.S. *Public Perception of Air Quality in New Brunswick.* Environment New Brunswick (P.O. Box 6000, Fredericton, N.B. E3B 5H1), Report 1-7601, 1976.

Radiation

Most radiation in the atmosphere comes from natural sources. For the past 30 years, however, man has been putting additional amounts into the atmosphere through nuclear explosions and fallout, use of radio-isotopes in medicine and research, operation of nuclear power plants, manufacture and transport of nuclear materials, and recently the disintegration of nuclear-powered satellites and other "space junk".

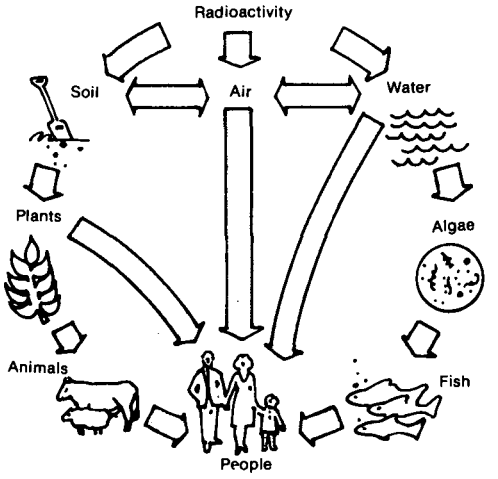


Figure 2.18 How Radioactivity Affects Man

Rem is the unit for measuring the effective energy absorbed from a particular radiation in biological tissue; a mrem is 1/1000 rem. The accepted maximum yearly individual dose, determined by the Atomic Energy Control Board, is 500 mrem. The International Commission on Radiological Protection suggests 170 mrem for large segments of the public. Natural background levels of radiation, according to the Hare report (Aikin et al.), are about 100 mrem per year across Canada. Man-made radiation contributes another 40 mrem, 35 of it from diagnostic X-rays. Nuclear fallout produces a further 6 mrem and occupational exposure and miscellaneous sources average an additional 4 mrem or so. The total then, averaged across the country, is said to be about 150 mrem per year.

However, these points are worth noting. First, different sources give different estimates for average exposures, with 180-200 mrem being cited often. Second, significant variations in background levels occur from place to place. Third,

fallout levels are relatively low at present but increase sharply whenever a nuclear device is tested (as in China, 1976 and 1977). This effect is likely to recur from time to time in future. Fourth, some individuals are much more exposed to radiation than others (workers in uranium mines and other nuclear facilities, operators of radiological equipment, etc.) and certain activities increase the exposure (flying from Montreal to Vancouver adds 5 mrem). Fifth, wide variations exist among individuals according to how much radiation they receive from X-rays (a single chest X-ray can produce 50 mrem and a pelvic examination is said to be capable of reaching 200). Sixth, some individuals are more predisposed to radiation damage than others (e.g. persons with allergies, asthma, heart disease and diabetes, and people who smoke). And finally, various authorities argue that, considering the uncertainties and risk involved, there are *no* safe dose limits for radiation.

Radiation is of concern for four reasons. First, a large dose produces acute physical damage, even death, to living organisms. Second, smaller doses sustained over longer periods of time, whether received directly or via concentration of radionuclides such as strontium-90 in food chains, can result in delayed physical damage, especially cancers and prenatal abnormalities. Third, genetic damage may occur to entire populations. Fourth, substantial hazards, in the special problem category of low probability but high risk, are associated with the use of nuclear fission as a source of energy, and that includes

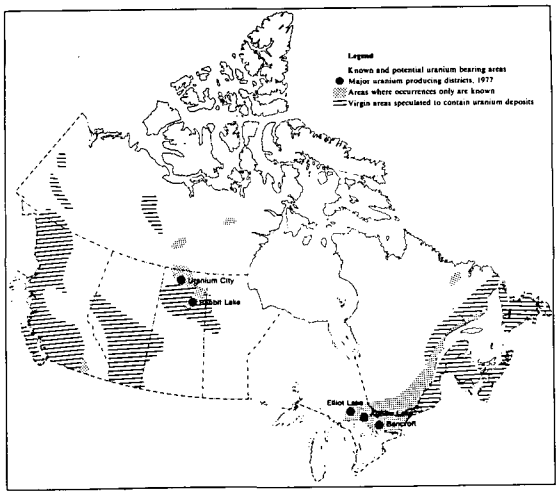


Figure 2.19 Uranium Deposits in Canada

Sources: Energy, Mines and Resources Canada, *An Energy Policy for Canada, Phase I, Volume II — Appendices* (Ottawa: Supply and Services Canada, 1973). Energy Mines and Resources Canada, *Energy Update 1977* (Ottawa: Supply and Services Canada, 1978).

the unresolved question of how and where to dispose of high-level radioactive wastes. Perhaps these wastes may constitute a resource since they contain exploitable energy; this includes waste heat from reactors which has potential applications to agriculture.

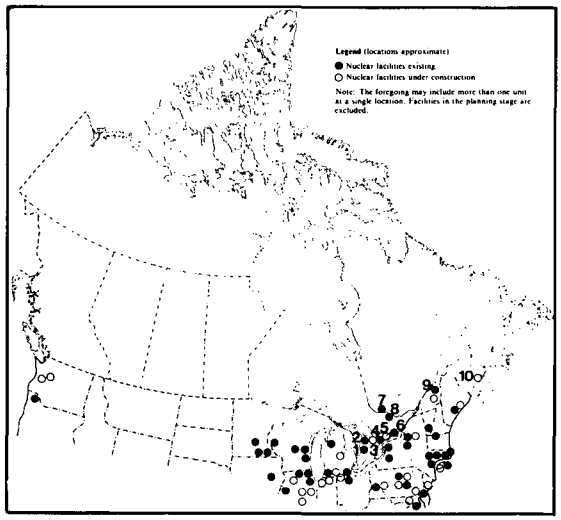


Figure 2.20 Nuclear Facilities in Canada and Northern U.S.A.

Main source: Canadian Nuclear Association and *Nuclear Engineering International*, April 1977.

Canadian Facilities

1 Whiteshell Nuclear Research Establishment
2 Bruce Nuclear Power Plant
3 Douglas Point Nuclear Power Plant
4 Pickering Nuclear Power Plant
5 Darlington Nuclear Power Plant
6 Nuclear Power Demonstration Station
7 Chalk River Nuclear Laboratory
8 Gentilly Nuclear Power Plant
9 Point Lepreau Nuclear Power Plant

Radiation as an environmental problem varies in severity across the country. Especially affected are areas where background levels of radiation are high (communities such as Port Hope, where radioactive materials were used for construction purposes, and others near exposed uranium sources where radon gas accumulates), where fallout tends to land, and where other air pollutants may act synergistically with radiation. Areas where nuclear facilities exist or are proposed (mainly Ontario, more recently Quebec and New Brunswick, and possibly Manitoba) are also more susceptible to radiation-related problems. The 1977 report of the

International Joint Commission (see 2.3 Water Quality), expressed concern over the increase in nuclear plants on the Great Lakes shore in the absence of a joint Canada-U.S. policy on radioactivity.

A special problem for the environmental planner is that information on causes and effects of radiation is highly technical, fragmented and often inaccessible – no single source exists relating radiation to other aspects of environmental planning – and difficult to assess, especially the possibilities of nuclear accident with associated damage and fallout on nearby and downwind areas.

Case Study 12
Radioactive Snow in the N.W.T.

In February 1978, residents of Fort Resolution were warned not to use the top layer of snow for making tea and not to eat the bones of game animals because of the discovery of a dusting of radioactive particles. Scientists believed they were residue from the nuclear core of a Soviet satellite that fell from orbit in January. Dr. Roger Eaton of Canada's Atomic Energy Control Board told reporters that the radioactive ash discovered at Fort Resolution and Pine Point and a broad track on the ice of Great Slave Lake had distinct properties indicating it was from the nuclear core. About 30 radioactive particles were found in the town of Fort Resolution. Dr. Eaton said their radioactivity reading was low but exposure to even one or two of them could affect human or animal health. These radioactive particles, which ranged in size from buckshot to peppergrains and were scattered at about three particles per square kilometre, were not detected in initial searches; they were identified a month after the satellite fell on earth, by helicopters flying search grids at 50 feet above the ground.

Dr. Eaton said the particles in populated areas would be picked up but it would be impossible to recover all the particles that fell in the vast wilderness. He took the position that determining the full extent of the environmental and health hazards was the responsibility of the Department of the Environment and other federal and territorial departments, none of which had at that time communicated any information to NWT residents.

See: "Tea from Snow Risks Atomic Ills, NWT Village Told", *Globe and Mail,* 28 Feb. 1978.

Case Study 13
Radon Build-Up, in Homes: Ontario's Regulatory Approach
Submitted by Beverley Hanna Thorpe, Ont. Ministry of the Environment

Radon is a chemically inert radioactive gas found in nature throughout Canada but especially in areas of uranium mining, processing and waste disposal (e.g., mine tailings). Radon can cause lung cancer.

Ontario is the site of much of the uranium-related activity in Canada (Saskatchewan is also prominent in this regard). Concern exists that radon build-up from natural and man-made sources exists or may exist in homes in parts of Ontario such as Elliot Lake, Bancroft and Port Hope. Controls of levels in homes in relevant areas is proposed using performance standards and amendments to the Building Code Act regulations. Responsibility for enforcement will fall on municipal building inspectors. A description of the standards and procedures is contained in the following report, coordinated by the Ontario Ministry of Housing and presented to the Environmental Assessment Board in March, 1978: *Elliot Lake: Protection from Radiation in New Housing,* February 1978 (available free from Ministry of Housing, Policy and Program Development Secretariat, 3rd Floor, 56 Wellesley St. W., Toronto M7A 2K4).

After hearing the Government's presentation, cross-examination and evidence-in-chief from the two mining companies (Rio Algom Ltd. and Denison Mines Ltd.) and the United Steel Workers of America, the Environmental Assessment Board issued a report to the Government on the issue of criteria and approval procedures with respect to naturally occurring radiation. The Board reached conclusions on the issues of radon and radon daughter criterion, gamma radiation, testing procedures, techniques of construction and methods of ensuring compliance. On the issue of radon gas the Board was satisfied that the Province had acted reasonably in adopting the 0.02 Working Level Criterion for radon and radon daughters. The Board suggested that the Government should review the available data on low-level radiation and re-evaluate the criterion which it has selected on a continuing basis. As the state-of-the-art knowledge on low-level radiation effects is primarily based on extrapolation from observed effects at high levels of exposure, continuing scientific investigation is required. Copies of the Board's report, *Criteria and Approval Procedures — Nat-*

urally Occurring Radiation in New Construction, Special Sitting, Elliot Lake Hearing, are available free of charge from the Ontario Environmental Assessment Board (5th Floor, 1 St. Clair Ave. West, Toronto, Ont. M4V 1J7).

An alternate viewpoint on this controversial issue is presented in Gordon Edwards, *Estimating Lung Cancer*, published by the Canadian Coalition for Nuclear Responsibility (2010 Mackay St., Montreal, Que. A3G 2J1), $3.00, and in the article "Radon Gas in Buildings. . . . in Homes", *CCNR Transitions*, June 1978.

Information Resources

See also:
2.7 Energy
4.7 Energy Projects

Aikin, A.M., Harrison, J.M. and Hare, F.K. *The Management of Canada's Nuclear Waste.* Dept. of Energy, Mines and Resources (Ottawa K1A 0E4), Aug. 1977. Paperback, 63 pp. Free.

The Hare Report, commissioned as a study on safe long-term storage of high-level radioactive waste in Canada, outlines the types and expected qualities of these wastes (including a clear, brief section on how reactors function), examines present methods of waste management, considers environmental and health impacts reflecting public concerns, looks at final disposal methods, and recommends as the preferred policy option a national plan (1978-2000) for the management and disposal of nuclear wastes. It concludes, "There are good prospects for the safe, permanent disposal of reactor wastes and irradiated fuel, and we see no reason why the disposal problem need delay the country's nuclear power program, provided that the government proceeds immediately to the program of research and development in the following (18) recommendations". In June 1978, the governments of Ontario agreed to launch the first phase of 25-year nuclear waste management program, as recommended by the foregoing report. Geological surveys of 1 500 possible sites are to begin later this year; test holes on 6-10 sites are scheduled for 1979-80. Contact Atomic Energy of Canada Ltd. (275 Slater St., Ottawa K1A 0S4).

Beckman, Peter. *The Health Hazards of Not Going Nuclear.* Golem Press (Box 1342, Boulder, Col. 80302), 1976. Paperback, 190 pp. $5.95 (hardcover, $10.95).

Cluff Lake Board of Inquiry. *Cluff Lake Board of Inquiry Report, Justice F.O. Bayda, Chairman.* Sask. Dept. of the Environment (Public Information and Education Branch, 1855 Victoria Ave., Regina S4P 3V5) July, 1978. 2 volumes. 1050 pp.

The Saskatchewan government established this Board of Inquiry in 1977 to investigate a $130 million uranium mine and mill project proposed at Cluff Lake. The report recommends that the uranium industry be allowed to expand provided that it conforms to strict new environmental, occupational and safety regulations. See also *The Saskatchewan Government Response to the Cluff Lake Board of Inquiry Report*, June 1978, 9 pp.

Environmental Assessment Panel on the Eldorado Uranium Refinery, Port Granby, Ontario. *Report of the Environmental Assessment Panel.* Environment Canada, Federal Environmental Assessment Review Office (Ottawa K1A 0H3), May 1978. 62 pp.

The Panel assessed, and recommended against, a uranium refinery proposed by Eldorado Nuclear Ltd. on a site on the north shore of Lake Ontario, at Port Granby about 75 km east of metro Toronto. Disposal of low-level radioactive waste on a hydrogeologically complex site adjoining the refinery was a major consideration in the Panel's decision. Others included intrusion of an industrial use into a stable agricultural area (largely Class 1 land), potential hydrogen fluoride emissions (crop damage) and social impacts. The site search and environmental assessment review process are continuing for sites in Hope Township, Sudbury and Blind River. Eldorado proposes a similar refinery at Warman, near of Saskatoon.

Gilmore, W.R. (ed.). *Radioactive Waste Disposal 1977: Low and High Level.* Noyes Data Corporation (Mill Road at Grand Ave., Park Ridge, NJ 07656), 1977. Hardcover, 364 pp. $39.00.

Based on federally funded studies, this book is concerned with the technological aspects of processing and storing both high and low level radwastes. Sections cover waste sources, high level waste treatments, non-high level wastes, storage (terrestrial disposal and transmutation concepts), isotope disposal, government and commercial facilities, and radwaste management by other countries.

Knelman, Fred H. *Nuclear Energy: The Unforgiving Technology.* Edmonton: Hurtig Publishers, 1976. Paperback, 259 pp. $4.95.

Knelman, who teaches at Concordia University, argues, "Nuclear power is a uniquely threatening technology whose wastes incorporate incredible toxicity, lasting for excessively long periods. The requisite conditions for control are eternal vigilance and totally fail-safe systems. The margin for error is virtually zero and the demand for infallibility is absolute". He sets out an agenda of nuclear issues, explains the technical aspects of nuclear power, traces the nuclear establishment, discusses nuclear safety and problems of proliferation, explores the enrichment issue, and examines energy options and ethical issues.

Law, Charles and Glen, Ron. *Critical Choice. Nuclear Power in Canada: The Issues Behind the Headlines.* Corpus (151 Bloor St. W., Toronto M5S 1S4), 1978. $10.50.

Covers radioactivity, nuclear fission, uranium fuel and radioactivity control (Port Radium, Port Hope, Elliot Lake), fuel cycles, nuclear wastes, nuclear energy in society, and moratorium vs. further development.

National Research Council, Commission on Natural Resources. *The Shallow-Land Burial of Low-Level Radioactively Contaminated Solid Waste.* National Academy of Sciences (Printing and Publishing Office, 2101 Constitution Ave. NW, Washington, DC 20418), 1976. Paperback, 150 pp. $7.00.

Ontario Coalition for Nuclear Responsibility. *Half-Life: Nuclear Power and Future Society.* CANTDU (Box 342, Goderich, Ont.), Aug. 1977. Paperback, approx. 500 pp. $10.00.

Presentation to Ontario's Royal Commission on Electric Power Planning (for other materials available from the Commission, write them at 14 Carlton St., 7th Floor, Toronto, Ont. M5S 1K5). Covers dangers of exploiting nuclear energy, hazards associated with fuel reprocessing and radioactive wastes, energy and society, electric power needs of Ontario, and arguments opposing nuclear power as the means of meeting these needs.

Organization for Economic Cooperation and Development, Nuclear Energy Agency, and International Atomic Energy Agency. *Uranium Resources, Production and Demand.* OECD (2 Rue Andre Pascal, 75775 Paris Cedex 16, France), Dec. 1977. 136 pp. $9.00.

Patterson, Walter C. *Nuclear Power.* Penguin Books, 1976. Paperback, 304 pp. $2.95.

Straightforward discussion of nuclear technology and the pros/cons of nuclear power.

Phillips, C.R. and Pai, H.L. "Environmental Impact of Radioactive Waste Management in the Nuclear Industry", *Water, Air and Soil Pollution*, Vol. 8, No. 2, June 1977.

The authors are in the Department of Chemical Engineering and Applied Chemistry at the University of Toronto.

Rothschild, H.C.A. *Criteria Digest on Radioactivity in the Environment.* National Research Council of Canada, Associate Committee on Scientific Criteria for Environmental Quality (Ottawa K1A 0R6), 1973. 53 pp. $1.50.

Science Council of Canada. *Policies and Poisons: The Containment of Long-Term Hazards to Human Health in The Environment and in the Workspace.* Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), 1977. 76 pp. $2.00.

Chapter 11, "Principal Lessons from Each of the Six Hazards Studies", includes a section on radiation. Annotated further in 4.3 Solid and Hazardous Wastes.

Skeptic, July/August 1976. $1.50 from Skeptic Magazine (812 Presidio Ave., Santa Barbara, CA 93101).

Special issue on "Nuclear Energy: Do the Benefits Outweigh the Risks?" Presents both sides of the argument and provides further sources for each.

Wyatt, Alan. *The Nuclear Challenge: Understanding the Debate.* Toronto: The Book Press, 1978. Paperback, 224 pp. Available from the Canadian Nuclear Association (65 Queen St. West, Suite 1120, Toronto M5H 2M5), $6.95.

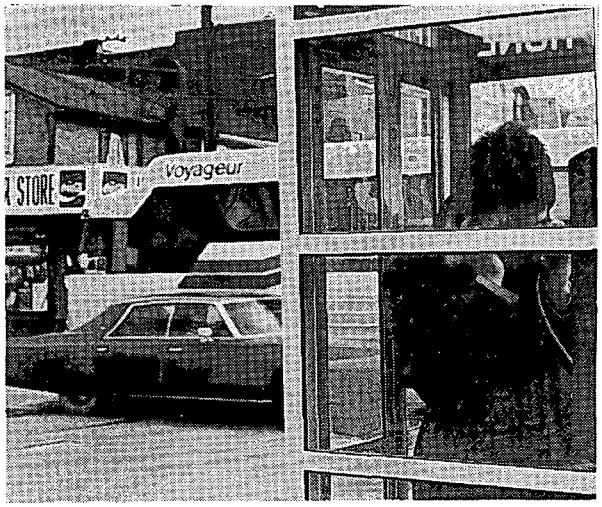
This book, on the development of nuclear power in Canada, is strongly critical of anti-nuclear, anti-technology advocates and "one-sided and distorted reporting of nuclear energy issues by segments of the news media". It examines energy and society, energy alternatives, health and economic aspects, safety and security, radioactive waste management, nuclear proliferation, the future role of nuclear power, the nuclear debate and the "anti-technology cult".

Noise

Noise, or unwanted sound, used to be looked upon as a sign of progress; the busy sound of street traffic may still be sweet music to a merchant's ear. More recently noise has been viewed as a regrettable but necessary fact of modern life, one of the tradeoffs accepted in working and commuting areas but, we hope, absent in the areas where most of us live and relax. Increasingly this attitude is changing as noise becomes louder and more pervasive. It has been estimated that noise levels in larger urban centres are doubling every ten years, which would make most urban dwellers deaf by the year 2000 (an estimated 5% of Canadians already have impaired hearing). At the same time, the public shows less willingness to put up with noise as increasing complaints attest.

If noise is becoming socially unacceptable it is for good reason. Excessive levels of sound, certain sounds in particular, can have a significant adverse effect on people's health, comfort and enjoyment. Of the sounds we hear in larger urban areas, it has been estimated that 7% are natural (leaves rustling, birds chirping), 25% are human in origin and the remaining 68% come from tools and technology. The latter group are the main sources of the "sound pollution" which detracts from the quality of the urban environment.

The determination of what is noisy contains a large subjective element; our own kids or dog are not as noisy as the neighbour's. Some of the physiological effects of noise, however, can be measured. Usually this is done on a weighted decibel (dBA) scale.



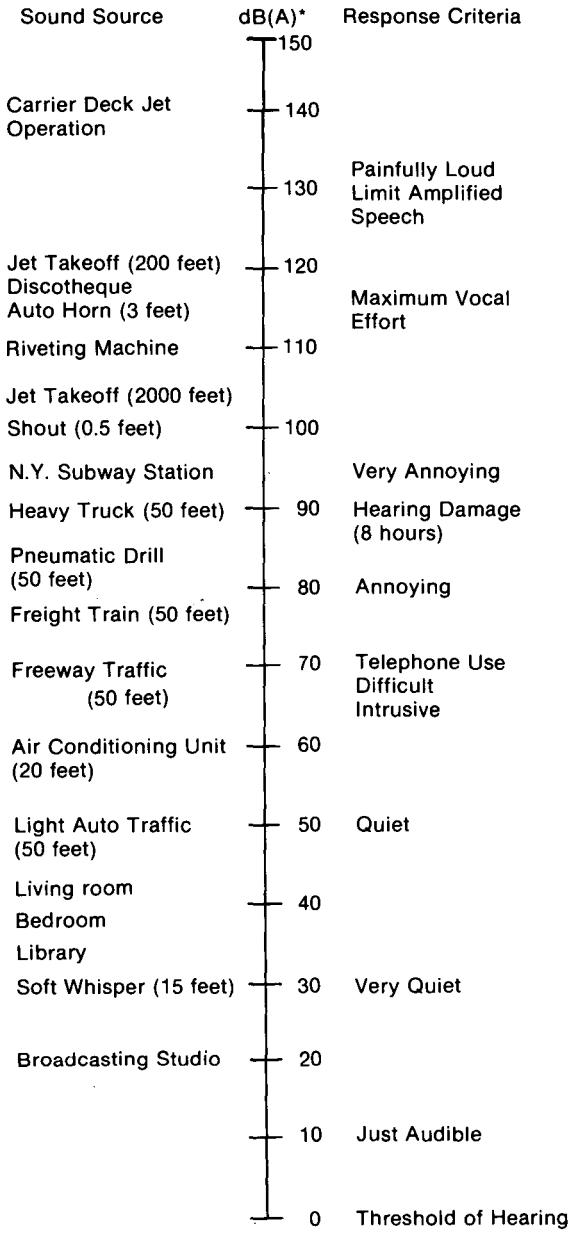


Figure 2.21 Levels and Effects of Noise

Decibels, named for Alexander Graham Bell, are measured on a logarithmic scale, not an arthmetic one. A 50 dBA sound plus another 50 dBA sound, therefore, does not produce a 100 dBA sound; in fact it equals only 53 dBA. That is, a 3 dBA increase is a doubling of the sound level. However, we don't *perceive* it as such. A 3dBA increase wouldn't be noticeable although a 6 dBA increase clearly is. A 10 dBA increase is perceived as only twice as loud even though it is actually 10 times as loud. And a 20 dBA increase, actually over 100 times as loud, seems only four times so. Frequency and duration of the noise are also factors to be considered. It has to be noted that such approaches are based on subjective responses to noise rather than on established relationships between noise and human health (both physical and mental) or effect on non-human life. Sufficiently conclusive knowledge necessary to permit the latter approach does not yet appear to exist.

Permanent hearing damage occurs when a person, such as a member of a rock band, experiences prolonged daily exposure to sound levels over 85 dBA. Noise also contributes to hypertension, ulcers and other conditions related to physical and mental stress. It can interfere with daily activities and it affects some people, such as the elderly, more than others. It is related to other environmental effects, such as ground vibration. It can lead to political pressure to take corrective action. Most often such pressure takes the form of legal measures, for example, enactment of a municipal noise control bylaw, or taking offenders to court. Noise bylaws, so far at least, are difficult to enforce; and the courts constitute a costly, slow and often frustrating course of action for those suffering from a noisy environment. While these measures will be increasingly needed and used they deserve to be complemented by preventive action, especially in the earlier land use planning and development control stages.

Table 2.6 Measures of Noise

Sound can be described according to its intensity, frequency, duration and character. More than 60 scales have been developed to relate the physical aspects of sound on a single-number basis to human perception and annoyance. Five of the most common are:

A-Weighted Sound Pressure Level: takes into account the manner in which the human ear responds to sounds of different frequencies. Emphasis is given to frequencies over 100 cycles per second (hz) since the human ear is more sensitive to higher frequencies. The A scale correlates with the subjective response as well as any other measure.

Equivalent Sound Level (L_{eq}): is the sound level of the continuous noise that would result from the summation of discontinuous sounds over a specific time period, usually 24 hours. Correlates best with cumulative noise effects.

Day-Night Equivalent Sound Level (L_{dn}): a modified version of L_{eq} which adds 10 decibels to the measured A-weighted sound level, during the period of 10pm to 7am, in determining the equivalent sound level for 24 hours.

Statistical Noise Level (L_n): indicates how frequently a particular sound level is exceeded. For example, L_{50} = 72 dBA means that 72 dBA was exceeded 50% of the time.

Community Noise Equivalent Level (CNEL): essentially the same as L_{dn} except that it gives greater weight to noise between 7pm and 10pm and even greater weight to noise in the 10pm–7am period. Incorporated in the computation are such objective factors as appropriateness of a noise to the situation, familiarity of the listener with the noise, and its character and duration.

Single-event Noise Equivalent Level (SENEL): a measure developed to quantify the subjective response to single noise events such as the blowing of a train whistle. SENEL responds to the observation that in a community the summation of annoyance from a single-event noise leads to a reaction to noise from such sources.

Such planning is probably most advanced in the vicinity of airports, aircraft noise being particularly severe and frightening. Two systems of noise-level contours, incorporating degree of annoyance likely to be produced in people experiencing such noise, are in use: Composite Noise Rating (Federal Ministry of Transport) and Noise Exposure Forecast (used by the Province of Ontario). To guide planners and/or provide the basis for development controls, land use compatability tables are prepared relating forecasted noise exposure to various land uses. At high levels (due to proximity, topography or other factors) certain land uses such as housing may be prohibited or noise insulation measures may be required.

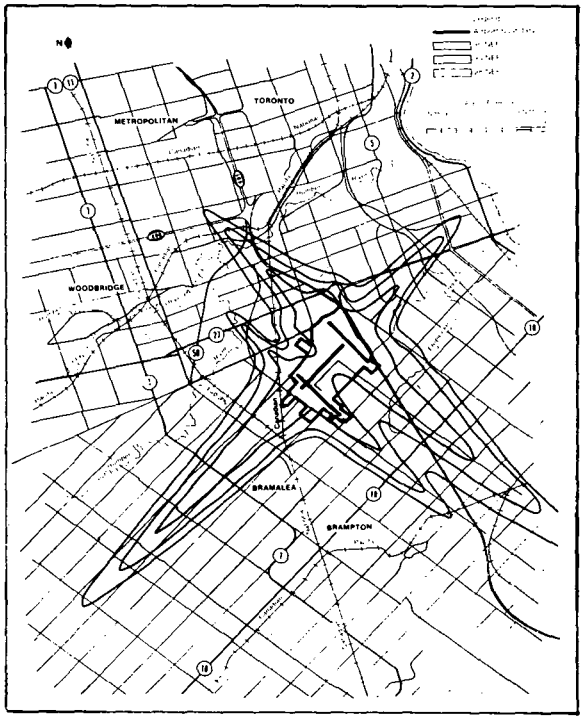


Figure 2.22 NEF Contours at Toronto International Airport, 1974

Source: Statistics Canada, Human Activity and the Environment (Ottawa: Statistics Canada, 1978). Noise Exposure Forecast calculations incorporate information on type of aircraft using the airport and the noise they generate, number of take-offs and landings on each runway and when these occur. NEF values increase logarithmically; a 10 NEF increase seems twice as loud. Adverse community reaction may start at around 25 NEF. Above 30 NEF complaints become increasingly vigorous and can be expected to result in concerted community action. With adequate sound insulation residential development may be possible up to the 35 NEF level.

Case Study 14
Study Planned on Noise Levels in Urban Areas in Ontario

Noise levels in urban areas are increasing each year and property values near major transportation corridors are dropping, according to Ontario's Ministry of the Environment. In response the Ministry is undertaking a two-year $65 000 study (funded through the Provincial Lottery Trust Fund) of the health effects of urban noise on residents across Ontario. The study, to be carried out by a group of consulting engineers, will concentrate on assessing the damaging effects on people of traffic, railway and aircraft noise in urban areas. Researchers will gather individual reactions to noise levels, conduct hearing tests and examine medical records of selected groups of urban residents. Completion of the study is expected in August 1979.

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Case Study 15
City of Toronto Noise Control Program

In the article cited below, the Commissioner of Public Works for the City of Toronto describes its program for control of noise, based on a Noise Control Study (by James F. MacLaren Ltd.). The study included (a) a physical survey on sound levels throughout the city using monitoring stations on a ¼-mile grid, and (b) a social perception study to pinpoint peoples' concerns about noise in the streets around their homes and at their workplaces. Ambient levels averaged 47 dBA for residential areas, 56 dBA for commercial areas and 58 dBA for industrial areas. Transportation was the predominant source of noise. Two-thirds of the people interviewed considered noise to be a problem but well behind air and water pollution in priority. They perceived noise to be increasing and registered a concern that it be controlled.

The City's program adopted the strategy of maintaining present sound levels, where acceptable, and controlling activities that might increase these levels at source using objective criteria. Action was taken in six areas: 1. land use (evaluating the potential impact on the

sound environment of proposals to change the nature or intensity of land use); 2. transportation (encouraging provincial and federal governments to upgrade limits of sound generation and initiate noise-level checks on vehicles); 3. noise attenuation in buildings (standards are proposed); 4. noise control bylaw (dictating acceptable levels for specific equipment and prohibiting certain noise during certain hours, rather than attempting to set lot-time limits for sound levels, and establishing a Noise Control Group for enforcement but with an emphasis on mediation); 5. construction and service equipment; and 6. program administration.

The City's approach has come under criticism from provincial Ministry of the Environment noise experts whose preferred approach is based on specific noise criteria and noise studies prior to approval of proposed developments.

See: R.M. Bremner, "The Programme for Noise Control in the City of Toronto", *Habitat* (Central Mortgage and Housing Corporation), Vol. 1, No. 1, pp. 9-18.

Information Resources

Alberta Transportation. *Alberta Surface Transportation Noise and Attenuation Study.* Alberta Transportation (9630 – 106 St., Edmonton T5K 2B8), 1978.

A study done in cooperation with Alberta Environment and the cities of Edmonton and Calgary.

Bender, E.K. et al. *Railroad Environmental Noise: A State of the Art Assessment.* Association of American Railroads (Environmental Studies Division, and Test Dept., 1920 L St. NW, Washington, DC 20036), 1974. 105 pp.

Bragdon, Clifford R. *Noise Pollution — The Unquiet Crisis.* Philadelphia, PA: University of Penn. Press, 1972. $15.00.

General introduction, with extensive bibliography.

Bugliarello, George et al. *The Impact of Noise Pollution, A Socio-Technological Introduction.* Toronto: Pergamon Press Inc., 1976. Hardcover, 461 pp. $20.50.

Central Mortgage and Housing Corporation. *New Housing and Airport Noise.* CMHC (Montreal Road, Ottawa K1A 0P7), 1978. 27 pp. Free.

See also a series of earlier publications from the federal Ministry of Transport, Civil Aviation Branch (Ottawa K1A 0N5): *General Comments on Aircraft Noise,* 1970; *A Description of the C.N.R. and N.E.F. Systems for Estimating Aircraft Noise Annoyance,* 1971; and *Land Use In the Vicinity of Airports,* 1972. The Ministry has produced Composite Noise Ratings for many Canadian airports. These contours have been used for land use planning purposes (with varying success) to estimate potential annoyance and promote adjoining development compatible with airport use.

Central Mortgage and Housing Corporation. *Road and Rail Noise: Effects on Housing.* CMHC (Montreal Road, Ottawa K1A 0P7), 1977. 107 pp. Free.

Central Waterfront Planning Committee. *Noise Information Base.* City of Toronto Planning Board (City Hall, Toronto M5H 2N2), 1976. $2.00.

One in a series of reports in the waterfront planning exercise (contact Linda Cardini, City of Toronto Planning Board). For a potential housing site adjacent to a noisy industry on the waterfront, monitoring was carried out and a site plan was developed incorporating noise barriers. All this was done in consultation with noise experts from the provincial Ministry of the Environment (contact John Manuel, P. Eng., Supervisor, Noise Control Section, Ontario Ministry of the Environment, 40 St. Clair Ave. W., Toronto M4V 1P5).

Goldsmith, John R. and Jonsson, Erland. *Effects of Noise on Health in the Residential Environment.* American Public Health Association (1015 18 St. NW, Washington, DC 20036), Aug. 1969.

Keyes, Dale L. *Land Development and the Natural Environment: Estimating Impacts.* The Urban Institute (2100 M St. NW, Washington, DC 20037), 1976. 128 pp. $4.95.

Noise is discussed in Part 4, pp. 103-117. General background information is followed by fundamental principles, a discussion of standards and measures of noise, analytical techniques both construction and transportation related, and conclusions and recommendations relevant to the planner.

MacKenzie, Leslie et al. *Noise Sound Silence.* Pollution Probe (43 Queen's Park Crescent E., Toronto M5S 1A1), 1974. Book, $2.00. Book, record and instruction cards, $4.00.

A kit aimed at teachers. The book alone is a primer on noise as an environmental problem.

Manning, J.E. et al. *Prediction and Control of Rail Transit Noise and Vibration: A State of the Art Assessment.* Cambridge Collaborative Inc., 1974. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, Va 22161), PB-233363.

National Bureau of Standards. *The Social Impact of Noise.* Washington, DC: U.S. Environmental Protection Agency, 1971. Paperback, 22 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 055-000-00047-6, $0.75 + 25% outside U.S.A.

Nelson, K.E. and Wolsko, T.D. *Transportation Noise: Impacts and Analysis Techniques.* Illinois Institute for Environmental Quality (309 West Washington St., Chicago, IL 60606), 1973. 120 pp. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, Va 22161), PB 226 806, $5.50.

Describes computerized models that can be used to assess the impacts of transportation noise generated by highway and airport facilities. The characteristics of transportation noise are discussed in terms of generation, effects and impacts, measurement and control. Economic, physiological, psychological and social effects of urban noise are described in detail.

Ontario Ministry of the Environment. *Acoustics Technology in Land Use Planning. Volume 1: Analysis of Noise Impact. Volume 2: Road Traffic Noise Tables.* Toronto: The Ministry, 1977. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $10.00 per volume, cheque payable to Treasurer of Ontario.

A two-volume training manual prepared to complement land use assessment under the Planning Act. Volume 1 describes the land use planning process in Ontario; introduces the subject of

acoustics; outlines the analysis of community noise including sound level limits, noise reduction methods, noise control measures, barrier calculations, building acoustics and materials, and measurement of sound with a sound level meter; and discusses the assessment of land use planning systems, with special attention to aircraft noise. Volume 2 provides detailed technical information on determining noise from road traffic and means of attenuating or otherwise reducing it (e.g., barriers). See also: Ontario Ministry of the Environment, *Model Municipal Noise Control Bylaw*, May 1976 and recent amendments.

Ontario Ministry of Housing. *Land-Use Policy Near Airports — Based on the Noise Exposure Forecast (NEF) System. March 1978. 4 pp. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8). Free.*

Pearsons, Karl S. et al. *Handbook of Noise Ratings.* Washington, DC: National Aeronautics and Space Administration, 1974. Paperback, 326 pp. Available from National Technical Information Service (5285 Port Royal Road, Springfield, VA 22161), N74-23275, $9.50.

Provides information on the multitude of noise rating schemes in use today, under four headings: direct ratings of sound level; computed loudness and annoyance ratings; communication interference ratings; and community response ratings.

Peterson, A.P.G. and Cross, E.D. Jr. *Handbook of Noise Measurement.* Concord, MA: General Radio Co., 1972.

Thiesson, C. *Effects of Noise on Man.* National Research Council of Canada, Associate Committee on Scientific Criteria for Environmental Quality (Ottawa K1A 0R6), 1976. 89 pp.

Urban Systems Research and Engineering, Inc. *The Audible Landscape: A Manual for Highway, Noise and Land Use.* U.S. Dept. of Transportation, Federal Highway Administration, Office of Research and Development (Washington, DC 20590), 1974.

U.S. Environmental Protection Agency, Office of Noise Abatement and Control. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.* Washington, DC: U.S.E.P.A., 1974. Paperback. 159 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $2.10 + 25% outside U.S.A.

Acknowledgements 2.3

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2.3 Water

Water meets a variety of human needs: for drinking and cleaning, for irrigation, for energy and industrial purposes as a cooling agent, for transport, for disposing of human waste, and for recreation. Water is also essential to non-human animal and plant life. The multipurpose character of water leads to differing standards of quality and the need to consider various uses in relation to each other.

Water resources fall into three categories: underground water, surface water and water vapour. Each relates to the others in the familiar hydrologic cycle which in turn relies on the sun's heat and gravity. Water that reaches us from the atmosphere through precipitation is continually returned to it through evaporation from land and water areas which it reaches as runoff, through the soil, and from transpiration by plants which takes water from the soil, where molecular attraction helds it between water and soil particles, into their root systems and pass it out through their leaves. Human and non-human life is heavily dependent on maintenance of this cycle.

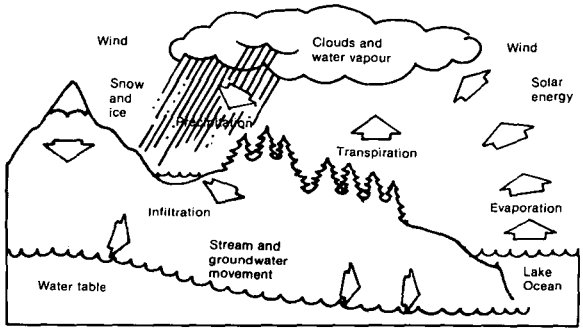


Figure 2.23 The Hydrologic Cycle

Groundwater refers to the water flowing under or contained below the earth's surface, usually in water-bearing formations called aquifiers. The top of the saturated zone is referred to as the water table. Groundwater is fed by rain and snow percolating through the soil, and by seepage from streams and lakes; in turn, groundwater returns through seepage to the earth's surface. The groundwater resource is susceptible to both depletion and contamination by human activities.

Surface water includes wetlands and estuaries, lakes and ponds, and oceans, comprising about 97% of the world's available water. The Great Lakes, North America's most prominent surface

water resource, have long provided water for domestic, industrial, transportation and recreational uses; they have also been a handy place to dispose of sewage and storm runoff. Creeks, streams and rivers collect and transport surface water with its load of sediment and pollutants to lakes and ocean. Watercourses are of major importance to their adjoining communities: for water power, irrigation, waste assimilation and transport, wildlife habitat, recreation, property value and amenity purposes.

The ability of water resources to continue delivering their benefits, and the extent to which "costs" such as erosion and flooding occur, are dependent on factors relating to both water quality and quantity.

Water Quality

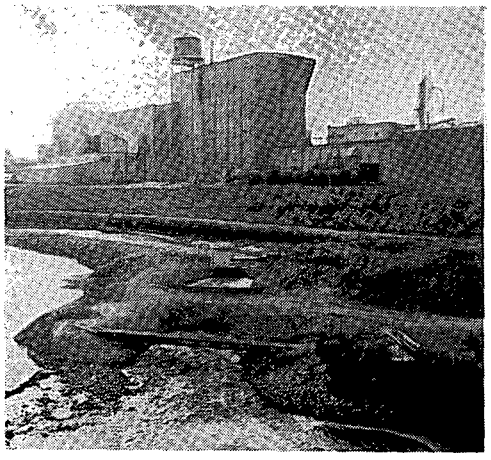
Water is eight parts oxygen to one part hydrogen by weight: H_2O. But it is more than that, as a close examination of "pure natural" water indicates. The water most of us encounter is hardly pure, and whether that is natural is debatable. Human activities have decreased water resources, especially since the late 1940s when resource substitutions began to create unprecedented environmental stress. Today most drinking water is a chemical feast, necessitated by the need to render it potable (safe to drink) and up to the level of quality people expect.

Water pollution can be defined in various ways. Common to most definitions is a concern for the concentration of specific pollutants over sufficient periods of time to cause certain effects

Table 2.7 Impurities in Natural Waters

Source	Particle Size Classification			
	Suspended	Colloidal/Dissolved		
		Molecules	Positive ions	Negative ions
Atmosphere	Dusts	Carbon dioxide Sulfur dioxide Oxygen Nitrogen	Hydrogen	Bicarbonate Sulfate
Mineral soil and rock	Sand Clays Mineral soil particles	Carbon dioxide	Sodium Potassium Magnesium Iron Manganese	Chloride Fluoride Sulfate Carbonate Nitrate Phosphates
Living organisms and their decomposition products	Algae Diatoms Bacteria Organic soil/topsoil Fish and other organisms Viruses Organic colouring matter	Carbon dioxide Oxygen Nitrogen Hydrogen Methane Various organic wastes	Hydrogen Sodium Ammonium	Chloride Bicarbonate Nitrate

Source: adapted from Amos Turk, Jonathan Turk and Janet T. Wittes, *Ecology, Pollution and Environment* (Philadelphia: W.B. Saunders Company, 1972).



which interfere with or limit human uses of the water. Recently that concern has been extended to basic interference with the functioning of aquatic systems. The capacity of an aquatic system to receive and assimilate waste depends on its characteristics (e.g. its ability to absorb atmospheric oxygen) as well as on the nature of the waste (chemical reactivity, settleability, etc.), its concentration and volume, hydrologic factors (vertical temperature profile, degree of mixing, etc.) and the nature of the source (intermittent vs. continuous, mobile vs. fixed, local vs. regional).

Table 2.8 Water Quality Characteristics

Characteristics	Parameters
Physical	Colour, odour, temperature, solids (suspended and dissolved residues), oils, grease
Chemical	Biochemical oxygen demand, chemical oxygen demand, total oxygen demand, total organic carbon, salinity, hardness, pH, iron content, manganese, chlorides, sulfates, sulfides, heavy metals, nitrogen, phosphorus
Bacteriological	Coliforms, fecal coliforms, specific pathogens, viruses

Pollutants act to alter aquatic ecosystems by:

1. Reducing the concentration of dissolved oxygen. Oxygen content is perhaps the most important and fundamental criterion for water quality. Pollutants such as domestic sewage, which need oxygen to decompose, compete with aquatic species which require oxygen to sustain life and activities. Water pollution control measures seek to maintain dissolved oxygen at a level sufficient to maintain normal functioning in aquatic species.
2. Reducing reproduction potential or by directly causing death.
3. Altering habitat or food sources (e.g., an increase in settleable solids may alter the bed of the waterbody and affect the growth of plant life).

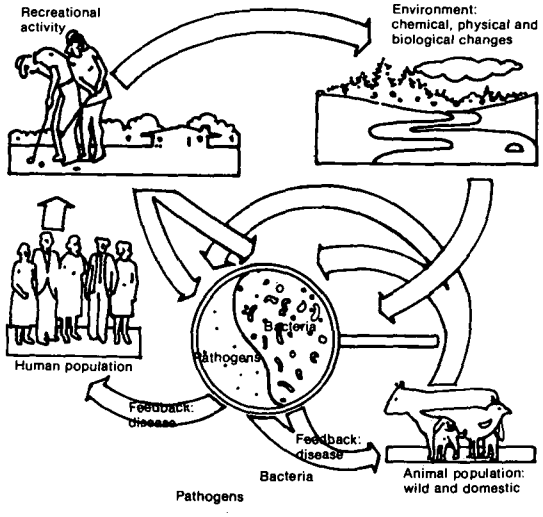


Figure 2.24 Water Pollution from Recreational Activity: Effect and Counter-effect

Adapted from: Ontario Ministries of Environment, Housing and Natural Resources, *Lakeshore Capacity Study, Progress Report* (Toronto: Ministry of Housing, Local Planning Policy Branch, Feb. 1978).

Overall, possible adverse effects of water pollutants on water resources include:

- Reduction of solar energy in the ecosystem and interference with photosynthesis.
- Increased input of nutrients, stimulating the growth of undesirable species which may replace preferred ones.
- Reduction in availability of nutrients, through increased sedimentation.
- Elimination or reduction of species and individuals by toxicity or thermal changes.
- Reduction of species diversity.
- Creation of hazards to human health.
- Reduction in recreational and aesthetic qualities of water resources.
- Reduction of use for commercial, industrial and agricultural purposes.
- Increased costs to finance corrective action, and associated opportunity costs.

Table 2.9 Water Pollutants

Oxygen demanding elements, such as those found in sewage and industrial waste, which reduce the water's level of dissolved oxygen necessary to sustain aquatic life and increase the concentration of bacteria.

Disease bearing agents from raw or partly treated human and other wastes. They threaten all forms of life and many result in reduced use of the water (e.g., "No Swimming").

Plant nutrients, from sources such as sewage effluent, may lead to excessive growth of algae and weeds through over-enrichment and premature aging (eutrophication) of the water body.

Inorganic and synthetic organic chemicals including oils, pesticides, detergents, etc. Often toxic to aquatic life and human use.

Heavy metals such as arsenic, mercury, lead and other trace metals. Toxic and cumulative (i.e., concentrate in body tissue as they ascend the food chain), contaminate food supply and can cause death.

Radioactive wastes such as radio-isotopes (thorium-230, radium-226, strontium-90, iodine-131, cesium-137). Danger to human health; also can be concentrated in food chains.

Sediment especially from urban and agricultural runoff. Destructive to bottom-feeding organisms; reduces available light within water bodies; interferes with photosynthesis thereby altering the aquatic system; reduces aquifer recharge function.

Heat imparted to a water body by industrial cooling and power plants (nuclear plants are a special concern) or by removing streambank vegetation. Can also be destructive to aquatic life.

Table 2.10 Nonpoint Sources of Water Pollution

Category of Non-Point Source	Pollution-Causing Activities	Principal Pollutants
Agriculture	Crop production, animal production, farm drainage	Sediment, nutrients from soil fertilization, pesticides, organic materials, salts, animal wastes
Forestry	Access road construction and operation, harvesting systems, logging (esp. clear cutting), crop regeneration, other silvicultural processes	Sediment, nutrients, pesticides, organic pollutants, thermal
Mining	Exploration, construction of facilities, mine operation, mine abandonment	Sediment, nutrients, waters, dissolved minerals, salinity, sometimes radiation
Construction	Land development, transportation and communication networks, water resource facilities, other	Sediment, chemicals, biological materials
Urban runoff	Precipitation discharges containing pollutants, accelerated and concentrated by urban surfaces and collection systems	Organic materials, inorganic solids, coliform bacteria, pesticides, nutrients, heavy metals and sediment
Hydrologic Modifications	Channel modifications, farm drainage, dams, resource recovery (especially sand and gravel) and related activities	Sediment, nutrients, pesticides, thermal, chemicals, microorganisms
Residual Wastes	Foregoing categories create residual waste (solid), liquid, sludge) not discharged to water but conveyed to it by runoff and infiltration	As above, both hazardous and non-hazardous. Examples: sewage sludge, solids from air pollution control equipment, mine tailings, feed lot wastes, pesticide containers, radioactive wastes

Approaches to controlling water pollution follow one or both of two directions:

1. Regulating the kinds and amounts of pollutants in given water bodies by setting water quality *standards*, based on *criteria*, for each desired use of the water.
2. Regulating the kinds and amounts of pollutants in the waste discharged to water bodies through the establishment of *effluent requirements*, often set for groups of industries (petroleum, pulp and paper, textiles, iron and steel, etc.)

Sources of water pollution can be separated into two types. *Point sources* are those readily identifiable at a single location. The main categories are industries, municipal sewage treatment plants, combined sewer overflows and raw sewage discharges. Nearly half of the population in Canadian cities over 100 000 is not served even by primary treatment of sewage, Montreal being the most notable example. *Non-point sources* comprise the other type — generalized discharges of waste whose location cannot be identified. The main categories are agriculture, forestry, mining, construction, urban runoff, hydrologic modifications and residual wastes.

For a long time, water control structures have been known to have a significant impact on land use, particularly through hydro-electric power development, flood control and drainage measures, and irrigation. Increasing recognition is now being given to the critical influence of land use on water resources, to what goes on beyond the water's edge. Controlling land use, for example, can aid in reducing the impact of many non-point pollution problems and provide an alternative to expensive sewerage and treatment facilities.

Concentrated human settlement especially affects water quality and quantity through: (a) physical change to the land, such as soil composition, increases in impervious ground cover, reduction in vegetative cover and topographical changes; (b) wastes generated by new inhabitants and industries; and (c) increased demand for water for domestic and industrial purposes. How severe these impacts are depends on the nature and intensity of land use on the one hand, and on the characteristics of the land on the other; the relationship is reciprocal. Planning, use, protection and control with respect to water and adjoining land resources, therefore, should go hand in hand.

Dozen Watch, Offer No Help as Boy Drowns

Reprinted from *Globe and Mail*, 6 June 1978 (emphasis added)

About a dozen people watched a 7-year-old boy drown Saturday and refused to jump into the Rivière des Prairies to save him, *some saying the water was too polluted.* Police said Martin Turgeon of Montreal slipped off a wharf near a spot where untreated sewage is dumped into the river.

"We're not going in there — the water is much too dirty," witnesses quoted one onlooker as saying. Some people even left the scene as the boy's father, a non-swimmer, thrashed about in the water and screamed for help. A boater fished the boy's body out of the river about 25 minutes later. "It makes you wonder about how human people are," a policeman remarked. "The boy probably would have been saved." The boy's family said they were too shaken up to talk about the incident.

Case Study 16
Water Management for a New Resort Community in Florida

St. George's Island is a barrier reef island off Florida's Gulf Coast on which an 800 acre residential and resort community was proposed. Planning and water management were deemed critical because of the need to conserve fresh water, prevent contamination of marshes and adjacent oyster beds, and otherwise protect ecological communities susceptible to changes in water flows and quality. The proponent decided to develop a prototypical resort community that demonstrates the best in environmentally sound development. Planning began with an ecological survey, recorded on a series of "eco-determinant" maps. Certain physiographic characteristics of the island were found to impose severe constraints on development: climate, high winds and tidal fluctuation, the dunes, the wetlands, soils and freshwater supply.

A landscape analysis discovered key features and then interrelationships in the natural system of the island. Five zones of suitability were identified: preservation, conservation, development, restricted waters, and open waters (i.e., open to all development which will not cause significant pollution or stress on the estuarine system). A conceptual site plan allocated land uses and spelled out design characteristics, taking into account the foregoing information; it was seen as a "diagram of relationships", to be refined and revised over time. Accompanying the plan as a means of safeguarding environmental quality was a series of environmental protection measures concerning misuse of beaches, dune erosion, vegetation destruction, roads and parking, marinas and boat use, commercial services, dredging and filling, building construction, storm runoff, siltation, water supply and salt-water intrusion, sewage disposal, irrigation, fertilizer, garbage disposal and other waste, trace metals and PCBs, pets and livestock, insect control, and operation and maintenance. The study, described during 1975, is continuing.

Documented in: John O. Simonds, *Earthscape: A Manual of Environmental Planning* (New York: McGraw-Hill, 1978), pp. 65-80.

Case Study 17
The Province of Ontario vs. Dow Chemical

In June 1978 the Ontario government ended its long-standing $35 million lawsuit against Dow Chemical Company. Dow ended up paying only $400 000. Of that amount, $250 000 was to be used by the Province for the settlement of damage claims; the remaining $150 000 was allocated to research.

Fishermen were put out of business when the government banned fishing in Lake St. Clair in 1970 after tons of mercury were dumped into it. Ontario sued Dow in 1971 claiming $10 million in costs to clean up the lake and $25 million for damage to the fishery. But the government's suit, launched with tough talk about polluters, soon bogged down in the courts. Meanwhile, the *Globe and Mail* (9 June 1978) noted, Ontario's Ministry of the Environment had given Dow almost $1 million in grants since 1971, most of it under the Pollution Abatement Incentive Act.

Case Study 18
Biochemical Oxygen Demand: Use With Care

Submitted by Wilson Eedy, Beak Consultants

The Hamilton Spectator in late 1977 reported that residents of an area in the nearby regional municipality of Halton complained about liquid

materials leaking from a chemical waste disposal dump site. A municipal official stated that tests showed the leaked substance had "a lower BOD than most treated sewage" and therefore was neither toxic nor worthy of concern. The issue subsequently faded from the public eye.

A fallacy may be at work here, however. If the chemical waste was highly toxic (as many such wastes are) it would have killed the bacteria which create biochemical oxygen demand through the breaking down (oxidation) of chemicals in the waste. A highly toxic substance in such a circumstance could have a BOD of zero. Low BOD levels are not necessarily equivalent to low hazard.

Case Study 19
Middle Maitland River
Water Quality Survey, Ontario
Submitted by Ian Deslauriers, Maitland Valley Conservation Authority

The Middle Maitland River is located in a watershed that drains to the eastern side of Lake Huron. In the early 1970s the Town of Listowel's sewage lagoon overflowed, polluting the river for several mills downstream. A study was undertaken to determine to what extent the incident had affected aquatic life. Ontario's Ministry of the Environment provided the field crew and research facilities. The study recognized that the river also feeds the local ground-water system; contamination of surface water could lead to deterioration in groundwater quality.

Upon completion of the study, the Ministry negotiated with the Town and the local industry whose activities had created the overload (the industry was built after the treatment facility). The lagoon operation was adjusted to cope with new peak loads.

Refer to:
Ontario Ministry of the Environment, Water Quality Branch, *Water Quality of the Middle Maitland River*, The Ministry (135 St. Clair Ave. W., Toronto M4V 1P5), March 1974.

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Information Resources

See also:
2.3 Water Quantity
2.3 Urban Runoff
3.1 Streams and Valleys
3.2 Inland Wetlands
3.3 Lakes
3.4 Marine Coastal Zone

Canada Dept. of Health and Welfare. *Canadian Drinking Water Standards and Objectives.* Health and Welfare Canada (Ottawa K1A 0K9), 1968.

Currently under review; revised publication expected later this year.

Castrilli, J.F. *Control of Water Pollution from Land Use Activities in the Great Lakes Basin: An Evaluation of Legislative, Regulatory and Administrative Programs.* International Joint Commission (100 Ouelette Ave., Windsor, Ont. N9A 6T3), 1977. 417 pp.

Study prepared for Fisheries and Environment Canada, Environmental Protection Service, sponsored by the Canadian Environmental Law Research Foundation. Examines government control of water pollution from non-point (land use) sources in the Canadian Great Lakes Basin including legislation, regulations and non-statutory programs which are being or could be used. Identifies the principal agencies and government levels with responsibility in this area and evaluates control efforts and policies to date. Generally environmental legislation, particularly provincial, was found to be sufficiently broad to prohibit pollution from non-point, diffuse sources.

Castrilli, J.F. and Dines, A.J. *Control of Water Pollution from Land Use Activities in the Great Lakes Basin: An Evaluation of Legislative and Administrative Programs in Canada and the United States.* International Joint Commission (100 Ouellette Ave., Windsor, Ont. N9A 6T3), March 1978. 109 pp. Free.

Carried out as part of the work of the IJC's Pollution from Land Use Activities Reference Group (PLUARG), this study presents a joint summary and comparative review of detailed separate studies of legislative, regulatory and administrative programs which address the control of pollution from land use activities in the Basin. Each land use activity is discussed (urban areas, agricultural liquid/solid/deep-well disposal areas, transportation corridors, shoreline land filling, extractive operations, forestry, recreation and shoreline erosion) including a summary description of the institutional framework relevant to that activity and evaluative observations based on background studies. The last section of the report discusses several policy issues that are generally pertinent. The study concludes that: the separation of agency authority for development planning and water pollution control may inhibit the effectiveness of nonpoint controls; environmental assessment law may not be an effective substitute for sediment control law; traditional enforcement processes for point-source pollution may be inadequate to control nonpoint-sources; intensified voluntary efforts may be insufficient to achieve adequate control over nonpoint-source and agricultural pollution; and the importance of an advocacy role for the public in administrative processes should be recognized.

Comité d'étude sur le fleuve Saint-Laurent. *Rapport du Comité d'étude sur le fleuve Saint-Laurent.* Services de protection de l'Environnement (2360 Chemin Ste-Foy, Ste-Foy, Québec), 1978. French and English.

This report is the result of a five-year study jointly financed by the provincial and federal governments. It includes: physical, social, economic and biological characteristics of the territory from Cornwall to Montmagny; an analysis of the quality of the water and sediments; and recommendations (each of which is covered in a separate supplement) for treating municipal and industrial sewage discharged from the river and 25 tributaries, improvement to municipal drinking water, conservation of biological resources through land acquisition, shore protection, modified dredging practices, and actions to deal with oil spills. Six additional supplements cover primarily legal initiatives concerning nutrients, toxic substances, suspended solids, bacteria, aesthetics and encroachment on the riverbed.

Contact:
D.A. Caillé, directeur, Comité d'étude sur le fleuve Saint-Laurent, Services de protection de l'Environnement.

Coughlin, R.E. and Hammer, T.R. *Stream Quality Preservation Through Planned Urban Development.* Washington, DC: U.S. Environmental Protection Agency, Office of Research and Monitoring, May 1973. 226 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), EPA-R5-73-019, $2.60 + 25% outside the U.S.A.

Study to determine the effects of urban development on water quality and stream channel enlargement. Further annotated in 3.1 Streams and Valleys.

Dillon, P.J. and Rigler, F.H. "A Simple Method for Predicting the Capacity of a Lake for Development Based on Lake Trophic Status", *Journal of the Fisheries Research Board of Canada*, Vol. 32, No. 9, 1975, pp. 1519-1531.

Presents a general technique (best suited to precambrian shield lakes) developed by the Ontario Ministry of the Environment and the Department of Zoology at the University of Toronto, for calculating

the capacity of a lake for development (summer cottages and other recreational facilities) based on quantifiable relationships between nutrient inputs and water quality parameters reflecting lake trophic status.

Dorcey, A.H.J. et al. *The Uncertain Future of the Lower Fraser.* Westwater Research Centre (University of British Columbia, Vancouver V6T 1W5), 1976. Paperback, 202 pp.

A review of water quality in the Fraser River, based on numerous individual studies. In British Columbia, major investigations have been undertaken concerning water quality in the Fraser River estuary and the Georgia Strait by Environment Canada, Environmental Protection Service (1001 West Pender St., Vancouver V6E 2M7), B.C. Research (3650 Westbrook Mall, Vancouver, V6S 2L2) and Westwater Research Centre. Contact the Centre for a list of available papers.

Edwards, C.A. *Environmental Pollution by Pesticides.* New York: Plenum Publishing Corp., 1973. Hardcover, 542 pp. $45.00.

Environment Canada. *Monograph on Comprehensive River Basin Planning.* Environment Canada, Inland Waters Directorate (Ottawa K1A 0H3), 1976. Paperback, 240 pp.

Annotated in 3.1 Streams and Valleys.

Environment Canada, Environmental Management Service. *Cutting Our Flood Losses.* The Service (Ottawa K1A 0E7), 1978.

This illustrated brochure outlines the new national Flood Damage Reduction Program which is designed to identify flood-prone areas (with flood risk maps) and discourage in them further development susceptible to flood damage.

Fisheries and Environment Canada, Inland Waters Directorate. *Surface Water Quality in Canada — An Overview.* Environment Canada (Ottawa K1A 0H3), 1977. 45 pp. Free.

Reviews the quality of surface waters in Canada, compared with 1960. Such quality is generally good (it has changed little in the past 25 years) in light of accepted guidelines and criteria, though dramatic regional differences exist due to variations in the nature and concentration of human activities, geology and natural phenomena such as climate.

Gibb, John E. and Jones, John F. *Pollution Hazard to Groundwater in Nova Scotia.* N.S. Dept. of the Environment, Water Planning and Management Division (Halifax B3J 2B7), 1974. 86 pp.

Contains sections on the nature and behaviour of groundwater and pollutants/contaminants in it, and on the adverse effects of septic tanks on groundwater quality.

Hydrocomp Inc. *Evaluation of the Effects of Urbanization on Aquatic Ecology and Hydrologic Regions.* National Technical Information Service (5285 Port Royal Road, Springfield, VA 22161), 1975. Publication No. PB 247-095.

International Joint Commission, Great Lakes Water Quality Board. *Great Lakes Water Quality, 1976 Annual Report.* International Joint Commission (100 Ouellette Ave., Windsor, Ont. N9A 6T3), July 1977. 72 pp. Free.

The IJC publishes annually a series of reports documenting its work and progress towards its objectives. An example: International Reference Group on Great Lakes Pollution from Land Use Activities, *Annual Progress Report,* July 1977. Annexes to the main report cover remedial programs, water quality criteria, surveillance, persistent toxic pollutants and radioactivity. See Castrilli, above.

International Reference Group on Great Lakes Pollution from Land Use Activities (PLUARG). *Environmental Management Strategy for the Great Lakes System.* International Joint Commission (100 Ouellette Ave., Windsor, Ont. N9A 6T3), July 1978. 173 pp. Free.

The final report of the PLUARG study addressed three main questions for its study area which encompasses 755 200 km² (295 000 square miles) and 37 million people in the industrial heartland of both countries. The first question was, "Are the boundary waters of the Great Lakes system being polluted by land drainage (including ground and surface runoff and sediment) from agriculture, forestry, urban and industrial land development, recreational and parkland development, utility and transportation systems and natural sources?" The Group answered with a resounding yes and warned that the situation will get worse in future if new initiatives are not taken. The Great Lakes are being polluted from land drainage sources by phosphorus, sediments, some industrial organic compounds, some previously used pesticides and some heavy metals. Agriculture and urban land uses are the main sources. The second question was "If yes, to what extent, by what causes and in what localities is the pollution taking place?" PLUARG found Lakes Erie and Ontario to be most affected by phosphorus (mainly from agriculture) and toxic substances (particularly mercury, lead and PCBs). Local areas experienced problems associated with sediment and microorganisms but soil type, land use intensity and materials usage were found to be the most important land-related factors affecting the magnitude of pollution from land-based activities. The third question was "What remedial measures would be most practicable and what would be their cost?" PLUARG responded that nonpoint-sources of pollution (the equivalent of a million tiny sewers) will be especially difficult to remedy; they are characterized by a wide variety and large number of sources, often seeming insignificant individually but producing large cumulative complex socio-economic interactions. Rather than across-the-board measures, management plans (comprising four components – information/education/assistance, planning, fiscal arrangments and regulation) are needed, focusing on priority problem areas. Identification of "hydrologically active areas", which because of their proximity to streams or aquifers contribute directly to ground and/or surface waters even during minor precipitation, could assist in estimating where and how much management was required. The Group concludes that existing legislation, programs, and control measures are generally adequate but not as well used or enforced as they should be. The level of resident awareness of pollution problems, however, is inadequate. Also, traditional yardsticks such as water quality objectives and standards are insufficient and potential pollution from disposal of radioactive and other toxic wastes causing a growing concern.

James, L.D. and Lee, R.R. *Economics of Water Resources Planning.* New York: McGraw-Hill, 1971. Hardcover, 615 pp. $20.50.

INTSA. *Issues Related to Interfacing Water Resource Planning and Land Use Planning: Development and Application of Quantitative Procedures.* Washington, DC: U.S. Dept. of the Interior, 1976. 210 pp. Contact INTSA (1120 Crane St St., Menlo Park, CA 94025).

Reports the results of a research project aimed at assembling information to guide water resource planning. Chapters cover the nature and role of regional planning in resource management, simplified quantitative modelling as an approach to regional resource planning, a demonstration of the approach in the Platte River Basin (midwest USA), fiscal cost analysis in water and related land resource planning with a demonstration in Richmond, California and site development cost modeling with a case study from Napa, California.

Keyes, Dale L. *Land Development and the Natural Environment: Estimating Impacts.* The Urban Institute (2100 M St. NW, Washington, DC 20037), 1976. 128 pp. $4.95.

Part 2, "Water Quality and Quantity", includes health, safety and welfare effects, legislation (U.S.), hydrologic principles, water related impacts of land development, methods of measuring and predicting impacts on flooding, water pollution, future discharge level, future ambient concentrations and water consumption, and conclusions relevant to the planner.

Keup, Lowell, E. et al. *Biology of Water Pollution.* U.S. Dept. of the Interior (Washington, DC 20240), 1967. 290 pp.

Collection of papers on stream pollution, waste water and water treatment.

Larkin, P.A. *Freshwater Pollution, Canadian Style.* Montreal: McGill-Queen's University Press, 1974. Paperback, 137 pp. $2.95.

Third volume in the series, "Environmental Damage and Control in Canada", sponsored by the Canadian Society of Zoologists. Introduces the subject of freshwater pollution by describing the biological characteristics of lakes and streams particularly in various regions of Canada; discusses the major kinds of pollution

(gross pollutants, heavy metals and mining, mercury, oil, herbicides and pesticides, pulp mill and other industrial pollutants, and wastes from power production) and the impact of the causal activities and land uses on the character of lakes and streams. The Canada Water Act is appended.

Leopold, Luna B. *Hydrology for Urban Land Planning.* U.S. Geological Survey (Washington, DC 20242), 1968.

Examines the effects of urbanization on streamflow characteristics. Study results indicated that the impervious area is slightly more important for streamflow than the area sewered. Information provided by this study (considered to be in the vanguard in 1968) was intended to provide criteria for use by planners in evaluating development proposals.

Loucks, Ronald H. and Associates et al. *Report on the Environmental Effects of the Proposed Lunenburg Joint Sewage Treatment Plant at Garden Lots.* Lunenburg County District Planning Commission (P.O. Box 341, Bridgewater, N.S. B4V 2W9), 1974. 73 pp.

The report was prepared in association with a Citizens Environmental Working Group for the Nova Scotia Department of the Environment after a proposed sewage treatment plant generated considerable local concern. The report discusses options for treating and disposing of sewage to the sea (sewage is now discharged untreated), recommends secondary treatment at a new plant, and discusses environmental and other implications.

McBoyle, G.R. and Sommerville, E. (eds.). *Canada's Natural Environment: Essays in Applied Geography.* Toronto: Methuen, 1976. Paperback, 264 pp. $8.95.

Part 3, "The Hydrological Resource Base in Canada", includes two papers: Quinn and Spence, "Canada's Surface Water Resources: Inventory and Management"; and Parsons, "Hydrogeology and Groundwater Resource Evaluation and Conservation in Canada".

McGauchey, P.H. *Engineering Management of Water Quality.* New York: McGraw-Hill, 1968. Hardcover, 295 pp. $20.00.

Metropolitan Area Planning Commission. *Halifax-Dartmouth Metro Area, Natural Land Capability.* N.S. Dept. of Development (Halifax, N.S.), 1973. 71 pp.

Study undertaken as part of the regional planning process for the Metropolitan Area Planning Commission. Water, both in quality and quantity, is the region's principal natural resource. Urban development of its watersheds, therefore, must proceed at a minimal cost while maintaining natural processes and protecting high-quality and sensitive areas. The study identifies the physical environment system (natural and manmade), environmental consequences of development (simplified ecosystems, loss of recreational opportunities, decline in amenity values, decline in property values, and engineering costs incurred to overcome environmental problems) and impact of development on the aquatic environment (quality and quantity). Costs are examined and areas suitable for urban development are identified using a computer-based mapping system.

National Research Council of Canada, Associate Committee on Scientific Criteria for Environmental Quality (Ottawa K1A 0R6). Various publications on water pollutants.

Ontario Ministry of the Environment. *Guidelines and Criteria for Water Quality Management in Ontario.* The Ministry (135 St. Clair Ave. W., Toronto M4V 1P5), undated. 26 pp. Free.

Ontario Ministry of the Environment. *Thames River Basin, Water Management Study.* The Ministry (135 St. Clair Ave. W., Toronto M4V 1P5), 1975. 131 pp.

A detailed assessment of water resource problems in this river basin together with a description and evaluation of water management proposals. Water quality modelling is covered and the entire subject of water quality receives substantial attention.

Simonds, John O. *Earthscape: A Manual of Environmental Planning.* New York: McGraw-Hill, 1978. Hardcover, 340 pp. $24.95.

Chapter 3 is a straightforward, attractive presentation of principles and practical measures for dealing with water-related environmental problems. It covers upland sources, streams, ponds and freshwater marshes, lakes and reservoirs, rivers and channels/canals, water resources and land development, tidal estuaries, beaches and dunes, the oceans and water management.

Tourbier, Joachim. *Water Resources as a Basis for Comprehensive Planning and Development of the Christina River Basin.* University of Delaware, Water Resources Center (42 East Delaware Ave., Newark, Del. 19711), 1973. 199 pp.

Tourbier, Joachim and Westmacott Richard. *Water Resources Protection Measures in Land Development — A Handbook.* University of Delaware, Water Resources Center, 1974. 237 pp. Being updated.

An outstanding two-volume study of the Christina Basin (for the U.S. Dept. of the Interior), widely applicable, which defines both land use controls and direct environmental measures to protect water quality and supply in areas undergoing urban development. The first volume discusses the water resource problems created by urbanization and sets out in detail an approach to water resources planning based on the site-class protection concept. Land in the watershed is classified into types, recognizing that certain landscape features are especially influential in determining surface and groundwater quality, quantity and movement. Natural characteristics were mapped, then grouped into 192 site classes (unique combinations of features); 41 of these appeared frequently and were selected for detailed evaluation of their contribution, in combination with various land uses, to water resource problems. The second volume spells out in detail (quantified, where possible) measures that can become an integrated part of urban development to lessen the problems that could adversely affect water resources (including runoff increases and and decreases, infiltration and a greater degree of erosion and sedimentation, flooding, runoff pollution and discharge of sewage effluent). Measures are presented and interrelated in flow charts. Each chart includes a specific description, site characteristics to which it applies, how it is applied, advantages and disadvantages, design criteria, specifications, cost guidelines and maintenance, and legal implications. Illustrated case studies are also given.

Troyer, Warner. *No Safe Place.* Toronto: Clarke, Irwin & Co., 1977. Hardcover, 267 pp. $13.95.

An angry book by an investigative journalist, focusing mainly on mercury pollution in north-western Ontario (with some examination of other parts of Canada). It documents, in particular, the Reed Pulp and Paper Mill's discharges into the Wabigoon River, consequent effects on the two Indian communities of White Dog and Grassy Narrows, and seven years of government non-action. Another book on the same subject, eloquently presented in word and photo, is: George Hutchison and Dick Wallace, *Grassy Narrows* (Toronto: Van Nostrand Reinhold Ltd., 1977), paperback, 178 pp. $8.95.

Turk, Amos et al. *Ecology, Pollution, Environment.* Philadelphia: W.B. Saunders Co., 1972. Paperback, 217 pp. $5.00.

Chapter 6 of this useful overview is entitled "Water Pollution".

U.S. Environmental Protection Agency. *Guidelines for State and Areawide Water Quality Management Program Development.* U.S. Environmental Protection Agency (Water Planning Division, Washington, DC 20460), 1976. 334 pp.

Section 208 of the Federal Water Pollution Control Act of 1972 requires, as a condition of federal assistance, the preparation of water quality management plans and development of continuing planning processes at state and local levels. Such plans identify water quality problems; establish goals and standards for water quality protection; delineate organizational and program responsibilities and iterrelationships for planning and implementation; establish the relationship between water quality management and other state programs and policies; and establish priorities and resource commitments for water quality program activities. These guidelines set out in detail what is involved in plan preparation and implementation. Chapter 13 covers "environmental, social and economic impact evaluation" briefly. An extensive annotated bibliography on "state water quality management planning" is included along with appendices setting out best management practices to minimize water pollution for categories of principal non-point sources.

Warren, Charles E. *Biology and Water Pollution Control.* Toronto: W.B. Saunders, 1971. $11.75.

Water Quantity

Weber, C.I. *Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents.* Cincinnati, OH: National Environmental Research Center, 1973. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), PB-227103. $12.50.

Water supply has long been a concern of Man, though less in Canada than in many other parts of the world. Quinn argues that prior to the mid sixties, the prevailing philosophy in this country was that Canada is wealthy in water; the main challenge was to make it available for use by means of structures for storing and/or withdrawing it from nature. Technical considerations (primarily hydrologic, engineering and economic) prevailed. Schemes were advanced, such as NAWAPA, to divert abundant Canadian waters to arid areas in southwest United States. In the late sixties public concern over Great Lakes pollution and adverse side-effects of massive dam projects and diversion schemes shifted the emphasis to more socially oriented and comprehensively planned water resource development focused on river basins and waterbeds. Studies such as the Qu'Appelle, Saint John and Okanagan were begun; their full impact on decision-making is still uncertain, however.

The domestic role of current federal-provincial environmental impact assessment in relation to major hydro developments is evidence that governmental decisions continue to be motivated by other goals. All of the recent election campaigns also indicate the lact of clout of environment as an issue in this period of widespread concern over employment and inflation. It remains potent locally, however, and has become accepted at high levels of decision-making as one more factor for consideration. For those who expected greater things in 1970, the realization must come that environmental impact assessments will continue to be made at the discretion of governments and not at the risk of interfering with political commitments; and that governments are reluctant to experiment much further with "public participation" as a means of determining the social acceptance of major resource developments.

Frank Quinn, Head (Social Studies Section, Water Planning and Management, Environment Canada), "Notes for a National Water Policy", in Ralph R. Krueger and Bruce Mitchell (eds.), *Managing Canada's Renewable Resources* (Toronto: Methuen, 1977).

Security of supply remains a central concern today, but has social and environmental undertones. A key question in the Saskatchewan-Nelson Basin water supply study, for example, is: if development is to continue in response to each new need, will there be future water shortages, or loss of environmental values, or both?

Although Canada cannot be said to have a water shortage, water supply is an issue in certain local areas due to insufficient quantity (whether in absolute terms or only in the dry years), the cost of developing it, competition among uses, and related water quality problems. Per capita domestic use of water in Canada is very high. The average person in a lifetime uses over a million and a half gallons, nearly half of it just to flush the toilet. Growth in population and industrial and commercial development continues to increase the demands upon water resources, especially in the urban industrial centres of the country.

Table 2.11 Water Use in Canada, 1974[a]

Province (gal/day)	Water Supply Systems Per Capita			
	Number	Pop. Served	Municipal[b]	Rural
Newfoundland	33	250 000	130	40
Prince Edward Island	5	35 000	80	35
Nova Scotia	35	406 000	96	35
New Brunswick	34	348 000	130	35
Quebec	220	4 615 000	136	35
Ontario	246	6 212 000	110	35
Manitoba	37	705 000	79	30
Saskatchewan	58	507 000	81	30
Alberta	73	1 282 000	109	30
British Columbia	64	1 718 000	126	40
Northwest Territories	—	—	83	35
Yukon Territory	—	—	275	40
Canada	**805**	**16 078 000**	**116**	**35**

a in municipalities with populations greater than 1 000
b includes municipalities not served by water supply systems

Source: Fisheries and Environment Canada, *Canada Water Year Book 1976* (Ottawa: Supply and Services Canada, 1976).

Flooding, the other main quantitative concern, is a natural process that has affected man since earliest time. Floods serve the beneficial function of soil enrichment – floodplains created as rivers erode and deposit material and provide valuable land for agricultural purposes – and they foster the environment required for certain plant and animal life. Floods, however, are more often remembered because of their potential for destruction. The problem is exacerbated by the location of buildings on floodplains, reducing flood capacity, and by human settlement which increases the amount and rate of runoff reaching the receiving waters. Dams, channels, floodways and development controls and other corrective measures, while beneficial can also have undesirable side-effects (damaging the stream habitat, for example). They may also encourage further encroachment on the floodplain.

The approach that relies on public works is being challenged by, and sometimes adapted to, a preventive approach that attempts to lessen the undesirable aspects of development at their origin, treats causes rather than effects, and integrates land and water resource planning.

Information Resources

See also:
2.3 Water Quality
2.3 Urban Runoff

Dillon, M.M. Ltd. and James F. MacLaren Ltd. *Flood Plain Criteria and Management Evaluation Study.* Toronto: Ontario Ministry of Natural Resources and Ontario Ministry of Housing, Dec. 1976. 77 pp. Available from Ontario Government Bookstore (880 Bay Street, Toronto M7A 1N8), $4.00, cheque payable to Treasurer of Ontario.

A summary report reviewing present policies and standards for flood plain management and identifying alternative design standards. Four other volumes provide background material on engineering, planning and economic aspects. The most significant recommendation of the Steering Committee, which co-ordinated and supervised the study, was to adopt a two zone floodway-flood fringe concept which would allow more intensive land use in the fringe areas of flood plains if special flood protection measures were adopted. Further annotated in 3.1 Streams and Valleys.

Fisheries and Environment Canada. *Canada Water Year Book 1976.* Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), 1976. 106 pp. $3.50.

Sections cover water resource planning and management (including a discussion of the planning process and description of each major river basin study underway), water use and development, floods and flood control, and water research in Canada.

Hjelmfelt, Allen T. Jr. and Cassidy, John J. *Hydrology for Engineers and Planners.* Ames, Iowa: Iowa State University Press, 1975. Hardcover, $10.95.

A recent hydrology text with emphasis on urban problems.

Lagacé, Michel, Pageau, Gérard and Dubé, Jean. *Milieux bio-physiques, frayères, végétation et invertébrés des sites des travaux de régularisation des eaux, région de Montréal.* Ministère du Tourisme, de la Chasse et de Pêche, Service de la recherche biologique (9530 Rue de la Faune, Orsainville, Qué. G1G 5E5), juin, 1977. 216 pp. Also: Comité sur la régularisation des eaux, région de Montréal. *Rapport final.* Ministère des richesses naturelles et Environnement Canada, 1976. 123 pp.

A case study of water resource management in the Montreal region. In response to flooding and shallow water problems, corrective measures were proposed: dredging, diversion, channel, control structures, etc. (second report). An inventory was conducted (first report) of the biological environments of some of the affected sites as the basis for an impact study of the proposed works. The research emphasizes the biological importance of several shallow, fast-running watercourses. The report describes the methods used, the results and their interpretation.

Marsh, William M. *Environmental Analysis for Land Use and Site Planning.* New York: McGraw-Hill, 1978. Hardcover, 292 pp. $22.50.

Chapter 5, "Floods and Floodplains", provides a brief, understandable treatment of the subject.

Quinn, Frank, "Notes for a National Water Policy", in Krueger, Ralph R. and Mitchell, Bruce (eds.). *Managing Canada's Renewable Resources.* Toronto: Methuen, 1977. Paperback, 333 pp. $9.95.

Tate, Donald M. *Water Use and Demand Forecasting in Canada: A Review.* Fisheries and Environment Canada, Inland Waters Directorate, Water Planning and Management Branch (Ottawa K1A 0E7), n.d.

This report reviews the state of the art with respect to demand forecasting and water use studies in Canada. Sections cover the need for water demand forecasting in Canada, general considerations in such forecasting, past Canadian studies in which urban water use and demand analyses have been significant; current and future studies and a summary and conclusion.

Waananen, A.O. et al. *Flood-Prone Areas and Land-Use Planning — Selected Examples from the San Francisco Bay Region, California.* U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), 1977. 75 pp. Stock Catalog. No. 1 19.16:942.

The study, co-sponsored by the U.S. Geological Survey and Dept. of Housing and Urban Development, was aimed at relating earth science information to problems of growth and development in the Bay Region. The report examines the regional flooding problems, describes the preparation and use of flood maps and flood information reports, lists information sources on flooding and floodplains, discusses flood-loss prevention and reduction measures, and examines the role of comprehensive planning in floodplain management. A case study of Napa Valley is presented.

Urban Runoff

A considerable share of urban-related water pollution is attributable to storm runoff carrying sediment and pollutants washed off hard surfaces and from adjoining areas. Such pollutants include petroleum products, salt used for de-icing, organic materials from street litter, heavy metals, asbestos from brake linings, heat, phosphates and nitrates from farms, oils and toxic materials spilled by industries, pesticides from golf courses and parks, and bacterial sewage from animal sources. The polluting characteristics of urban runoff are being increasingly recognized, and some areas are postponing tertiary sewage treatment until storm runoff can be dealt with. Studies have shown it to be similar to and sometimes worse than domestic sewage.

Urban development as now practiced, views storm runoff as a problem to be "solved" by construction of roof drains, storm sewers and major drainage works. Little attempt is made to reduce or manage either the amount or the rate of runoff, thereby overlooking three factors:

- Urban development increases the *amount* of storm runoff. Because urban areas have more hard surfaces (paved streets, sidewalks, parking lots, roof tops) than rural areas, more water runs off. Figure 2.25, derived from the Philadelphia area, shows the considerable increase in the amount of runoff resulting when an area is transformed from natural ground cover (10% runoff) to nearly all paved (55% runoff).

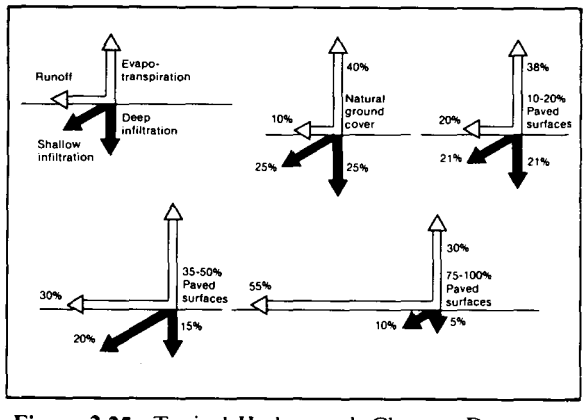


Figure 2.25 Typical Hydrograph Changes Due to Increasing the Area of Impermeable Paved Surfaces in a Developing Area the Area

Source: Joachim Tourbier, *Water Resources as a Basis for Comprehensive Planning and Development of the Christina River Basin* (Newark, Delaware: University of Delaware, Water Resources Centre, 1973). Reproduced with permission.

- Urban development increases the *rate* of flow of runoff. In non-urban areas that precipitation soaks slowly into the ground, seeps down to the water table, and eventually reaches a watercourse or water body. In urban areas all this happens much more quickly as a result of eavestroughs, downspouts, weeping tiles, concrete and asphalt gutters, catchbasins and storm sewers. More flooding is one probable consequence, and that triggers the building of flood control structures and larger storm sewers. Straightening and concrete-lining a stream, however, further speeds up the rate at which the water runs away. Result: high peaks of flow which quickly dissipate leaving very low or no flow (necessitating flow augmentation measures, with another round of adverse effects). By contrast, a natural stream area is slow to reach its peak flow and slow to run dry. A concrete channel also loses another advantage of a natural stream: its ability to cleanse itself gradually of pollutants, a function of the diverse plant and animal life a natural stream supports plus its relatively constant temperature and flow. Another adverse effect is reduced groundwater recharge which has an impact on water supply.
- Increased quantities and rate of urban runoff can lead to increased erosion, increased infiltration into sanitary sewers, overflow of combined sewers, and the need to by-pass sewage treatment during peak flows. Increased water pollution follows, adversely affecting the use potential of receiving waters for both urban and rural purposes (e.g., interfering with irrigation and crop production timing)



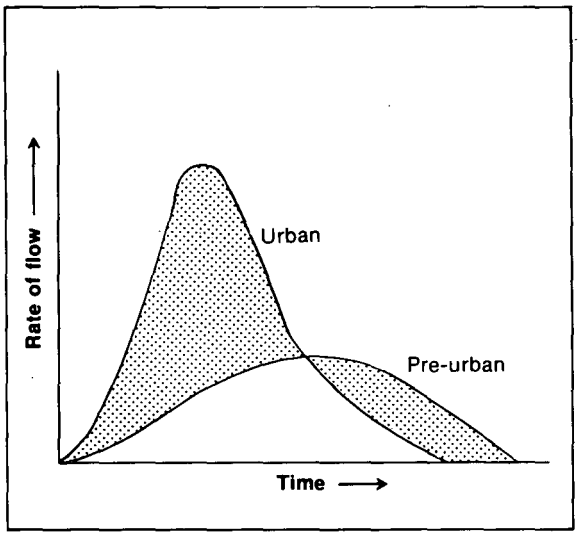


Figure 2.26 Effects of Urbanization on Volume and Rate of Surface Runoff

Source: Environment Canada and Ontario Ministry of the Environment, *Modern Concepts in Urban Drainage: Conference Proceedings No. 5* (Ottawa: Environment Canada, 1977).

For a long time, the design of storm sewerage and drainage systems has given priority to quantity over quality. This may be attributable in part to conventional engineering design practice and in part to municipal attitudes. A survey of urban drainage practices across Canada indicates that municipalities tend to see quantity as their business, while quality the responsibility of the provincial government (Environment Canada and Ontario Ministry of the Environment, 1977). Other reasons: lack of awareness of the serious pollution hazards in storm runoff (thought of as simply rain) especially in urban areas; a failure to grasp fully the hidden costs, including environmental, of combined systems and local practices affecting runoff (e.g., connecting downspouts to the sewer rather than letting them spill their contents onto the ground); and lack of coordination among the various municipal activities, such as street cleaning and snow removal, affecting runoff quality.

Provincial and municipal governments in recent years have moved beyond a narrow quantitative approach to stormwater. More consideration is being given to the quality of runoff, and quantity itself is being re-examined. A few municipalities require developers, to minimize stormwater discharge from their sites (sometimes given the misleading label, "zero runoff") through provision of on-site retention or storage of runoff. Such a preventive approach is characteristic of environmentally oriented management. Few places, however, have progressed to the next step: re-introducing runoff to natural systems and undertaking overall municipal stormwater management within a watershed context. (Juneja).

Case Study 20
Combating River Pollution from Runoff into Wright's Creek, P.E.I.

Submitted by Philip Wood, P.E.I. Land Use Service Centre

Wright's Creek is a small river running through the valley of East Royalty on the edge of Charlottetown. This primarily rural community is experiencing considerable development pressure, especially along the Creek. Urban runoff, siltation and nutrient enrichment from farming operations are creating problems for the Creek and adjoining ponds. What was once an attractive and productive river system for trout, salmon, waterfowl and small mammals, has seriously deteriorated. A threatened addition to the problem is the proposed construction of a new airport at the headwaters of the river system. Plans call for all runoff from the airport to be channelled into Wright's Creek.

East Royalty's official plan identifies the Creek with its ponds and woodlands as (a) a "significant natural area" and a potential linear open-space system, and (b) "hazard lands" because of soil and slope conditions. Policies in the plan promote rejuvenation of the river system through tree planting, runoff and erosion controls, construction of a fish ladder, and other maintenance and improvement measures. Runoff from the airport is seen as both a problem and an opportunity; while pollution is a real threat, increased flow may produce a desirable flushing action. These issues, it is expected, will be resolved as airport construction progresses.

Case Study 21
Increased Flooding in an Urban Watercourse, Metro Toronto

Submitted by Metro Toronto and Region Conservation Authority

Highland Creek is located in the Borough of Scarborough in Metropolitan Toronto. On 27 and 28 August 1976 severe thunderstorms, dropping 1.69 inches and 2.24 inches of rain respectively, caused significant flooding on the Creek

with damage reaching nearly $2 million. The 27 August storm had an estimated return period of 20 years yet produced a one-in-37-year flood. The storm of the following day, though more severe in terms of rainfall, resulted in less damage because its peak flow was routed through a number of small reservoirs created by the earlier storm. The policy of the Metro Toronto and Region Conservation Authority, to restrict the encroachment of private development on floodplain lands, helped minimize the severity of damage by the two floods.

Highly efficient man-made channels in the upper watershed, combined with a substantial urbanization in the watershed over the past 25 years, have greatly increased the potential of flooding on the more natural meandering reaches of lower Highland Creek. Return period for given flow values will continue to decrease; that is, while return periods for given storms (rainfall) are likely to remain constant, high flows (floods) will occur with greater frequency. The creek valley now serves two main functions: as open space and as stormwater collector. It should be able to continue performing this dual role provided that action is taken to keep the two functions compatible. This will mean avoiding building constrictive structures, locating open-space facilities out of the way of high-flow velocities, protecting banks, investigating stormwater management approaches as alternatives to reliance on storm sewers and channelization, and similar measures.

Refer to:
Kilborn Ltd., *The Storms of August 27th and 28th, 1976 on the Highland Creek, Metropolitan Toronto,* prepared for the Metro Toronto and Region Conservation Authority (5 Shoreham Drive, Downsview, Ont. M3N 1S4). 12 page summary available from MTRCA; full report may be borrowed.

Contact:
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Head, Flood Control and Water Conservation Section
Water Resource Division
Metro Toronto and Region Conservation Authority
5 Shoreham Drive
Downsview, Ont. M3N 1S4
(416) 661-6600

Information Resources

See also:
2.3 Water Quantity
2.3 Water Quality

Alberta Dept. of the Environment. *Objectives for Storm Water Management.* Alberta Environment (9820-106 St., Edmonton T5J 2J6), 1976.

Sets out a provincial policy on stormwater management.

American Public Works Association. *Water Pollution Aspects of Urban Runoff.* U.S. Dept. of Interior (Washington, DC 20240), FWQA Research Report No. WP-20-15, January 1969.

Focuses on quantifying the contribution of street dirt and other surface debris to runoff and stream pollution. See also the more recent document, *Practices in Detention of Urban Stormwater Runoff* (APWA, 1313 East Sixtieth St., Chicago, Il 60637), 1974, 231 pp., $12.50. It presents results of a survey of use of 1 400 on-site detention facilities in over 100 municipalities in U.S. and Canada. Many applications of on-site detention were identified in which substantial cost savings over conventional urban stormwater drainage systems were realized. The report predicts the increased use of this approach.

Canada-Ontario Agreement on Great Lakes Water Quality, Urban Drainage Subcommittee. *Manual of Practice on Urban Drainage, Draft No.3.* Ontario Ministry of the Environment, Water Resources Branch (135 St. Clair Ave. West, Toronto M4V 1P5), March 1977. 383 pp. + appendices.

The subcommittee, part of the research program under the Agreement, is developing two urban runoff models: Storm Water Management Model (SWMM) to simulate storms and predict associated flow and pollution; and Storage, Treatment, Overflows and Runoff Model (STORM), a simpler model capable of performing quantity/quality computations and assessing the influence of different storage and treatment capacities on the magnitude of overflows. A newsletter describes work on the two models (CANSWMM Newsletter, available from Ontario Ministry of the Environment, Water Resources Branch). Another project is the Manual, aimed at identifying the seriousness of urban drainage problems, identifying and describing cost-effective solutions, presenting problems and solutions in a framework of inter-agency cooperation, achieving urban stormwater management, and generally contributing to Great Lakes water quality objectives. Chapters cover urban drainage problems, urban drainage planning, design techniques, source controls for quantity and quality of urban drainage, collection/storage/treatment and alternative solutions, and administration and implementation.

Economic Systems Corporation. *Storm Water Pollution for Urban Land Activity, A Report to the Federal Water Quality Commission.* U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), 1970.

Examines the relationship between various characteristics of urban development and stream quality at typical flow conditions. Streamwater quality decreases with increasing population density and with the amount of development, particularly as measured by land devoted to streets, the type of streets, the amount of main covered storm sewers, and the ratio of covered storm sewers to total length.

Enviro Control, Inc. *Total Urban Water Pollution Loads: The Impact of Storm Water.* Washington, DC: Council on Environmental Quality, 1974. 183 pp. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), PB-231 730. $7.50.

Analyses engineering survey data from eight cities and effects of storms on water quality in the Delaware River estuary. Estimates quantities of pollutants entering receiving waters from cities, determines the portions (particularly the stormwater-related sources) attributable to sources other than sewage treatment plants, compares the costs and effectiveness of reducing pollution from stormwater, and discusses policy implications.

Environment Canada and Ontario Ministry of the Environment. *Modern Concepts in Urban Drainage: Conference Proceedings No. 5.* Environment Canada, Environmental Protection Service (Ottawa K1A 1C8), March 1977. 389 pp. Free.

Proceedings of a conference that provided an overview of the Canada-Ontario Urban Drainage Program, pollution sources and their effects, the applications of computer models for analyzing urban drainage problems, and existing practice and policies. Papers covered: urban drainage problems; a municipal engineer's view of urban drainage; water quality aspects of urban runoff; hydrologic and political aspects of urban drainage; a review of urban runoff models; data collection, instrumentation and verification of models; application of computer models to storm water management; treatment technology for urban runoff; a CMHC-sponsored systems demonstration of the STORM and SWMM models and other stormwater management technology in St. Thomas, Ontario, (a municipality with urban drainage problems of local flooding, combined sewage overflows and sewage treatment bypasses); urban drainage design for new development; urban drainage practices in Canada; erosion control methods during construction; and an introduction to the Manual of Practice of Urban Drainage, mentioned earlier.

Environment Canada and Ontario Ministry of the Environment. *Storage and Storm Water Quality Control: Meadowvale Test Site Study.* Environment Canada, Environmental Protection Service (Ottawa K1A 1C8), 1977. 65 pp. Free.

A case study of the application of the two computer models, SWMM and STORM, to a test site and in-stream settling basin-reservoir system in the "new community" of Meadowvale in the City of Mississauga, Ontario. The settling basin-reservoir system is expected to "significantly improve" runoff characteristics (when it had been predicted that uncontrolled urbanization, largely residential, of the Meadowvale catchment would lead to a deterioration in runoff quality). Estimates indicate that the Meadowvale system will reduce peak flows to pre-urbanized levels or less for storms with return periods of less than one year. Future measurements are required to calibrate the applied models, verify the assumptions and check out the foregoing predictions.

Field, Richard, et al. *Urban Runoff Pollution Control Technology Overview.* U.S. Environmental Protection Agency (Office of Research and Development, Municipal Environmental Research Laboratory, Cincinnati, OH 45268), 1977. 91 pp.

Hartt, James P., "A Study of Pollution Loadings from Urban Runoff", *Water Pollution Research in Canada,* Vol. 8, 1973, pp. 16-25.

Examines the quantity of runoff pollutants in pounds per acre per season and produces qualitative values, ranges of values and mean values on a seasonal and annual basis for 19 physical, chemical and bacteriological parameters. Such values are useful in estimating the impact of urbanization on a given area or in determining the resulting pollution load caused by changes at the planning stage, for example in land use, population density or intensity of urbanization. The study's key conclusion: "Storm runoff pollution loading is probably greater than the effluent from municipal secondary sewage treatment plants. At this point, no one has made a convincing case to indicate that tertiary treatment is more important than treating storm water, in the overall long range plan for protecting the environment".

Juneja, Narendra. *Medford: Performance Requirements for the Maintenance of Social Values Represented by the Natural Environment of Medford Township, N.J.* Medford Township Office (Box 397, Medford, N.J. 08055), 1974. 64 pp. $6.00.

The McHarg method impressively applied to a rural township. The study includes proposals for "surface water management" (including runoff, erosion of nutrient-application controls), groundwater management (primarily aquifer recharge), runoff management (no alteration to be permitted to the amount of runoff presently occurring, as identified in a Runoff Management Chart, with excess runoff to be recharged locally into the ground through the use of recharge ponds or injection wells) and erosion management (restricting soil loss to a maximum of 3 tons/acre/year by using interceptive devices such as berms and siltation ponds).

Koch, F.A. et al. *Toxic Substances in the Wastewater from a Metropolitan Area.* Westwater Research Centre (University of British Columbia, Vancouver V6T 1WJ), 1977.

Metropolitan Toronto and Region Conservation Authority. *Storm Water Management Proceedings.* MTRCA (5 Shoreham Drive, Downsview, Ont. M3N 1S4), 1977. 41 pp.

Five papers describe the Authority's concerns with respect to stormwater management, various methods and the public works viewpoint. The Authority currently is developing hydrologic/hydraulic computer models for all watersheds within its jurisdiction to identify effects of changing land uses particularly with respect to flood levels and flow characteristics.

Michigan Dept. of Natural Resources. *Michigan Guidebook, Soil Erosion and Sedimentation Control.* Dept. of Natural Resources (Stevens T. Mason Bldg., Lansing, Michigan 48926), 1975.

Sartor, J.D. and Boyd, G.B. *Water Pollution Aspects of Street Surface Contaminants.* Washington, DC: U.S. Environmental Protection Agency, 1972. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), PB-214 408. 236 pp. $8.00.

Analysis of a hypothetical city of 10 000 people on 14 000 acres of land indicated that a moderate to heavy storm, with brief peaks to at least 1/2 inch per hour, would contribute considerably *more* pollution load than would the city's sewerage system during the same time period. In every measure of pollution except for coliform count, storm runoff produced substantially more pollution than raw sewage. This study provides a basis for evaluating the significance of stormwater as a form of pollution relative to other sources, for a wide range of community sizes and locations and pubic works practices.

Tourbier, J. and Westmacott, R. *Lakes and Ponds.* Urban Land Institute (1200 18th St. NW, Washington, DC 20036), 1976. 70 pp.

Discussion of the use of lakes and ponds, particularly man-made, in urban developments. Includes design criteria, problems and benefits, and legal and management considerations.

Urban Land Institute et al. *Residential Storm Water Management: Objectives, Principles and Design Considerations.* Urban Land Institute (1200 18th St. NW, Washington, DC 20036), 1975.

Vitale, A.M. and Sprey, P.M. *Total Urban Water Pollution Loads: The Impact of Storm Water.* National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), 1974.

The report concluded that, after secondary treatment is provided, 40-80% of the total annual Biochemical Oxygen Demand and Chemical Oxygen Demand entering receiving waters from a city is caused by sources other than the sewage treatment plant, and that urban stormwater is the culprit. The report recommended analyzing the *total* urban pollution load in water quality planning, and suggested that cities refrain from seeking treatment beyond the secondary level until the urban stormwater situation is corrected.

Waller, D.H. *Pollution Attributable to Surface Runoff and Overflows from Combined Sewerage Systems.* Central Mortgage and Housing Corporation (Montreal Road, Ottawa K1A 0P7), 1971.

Final report on a research project in Halifax, providing data on composition of combined sewage, surface runoff, roof runoff and effluent from a combined sewage retention tank. The author is a professor in the Department of Civil Engineering, Nova Scotia Technical College, Halifax, N.S. See also: Waller et al., *Urban Drainage Model Comparison for a Catchment in Halifax, N.S.*; and D.H. Waller and W.A. Coulter, *Winter Runoff From an Urban Catchment.* Both reports, prepared under the Canada-Ontario Agreement on Great Lakes Water Quality, are available from Environment Canada,

Environmental Protection Service (Ottawa K1A 1C8).

Warnock, Richard G., "A Study of Pollutional Loadings From Urban Storm Runoff", *Canadian Symposium on Water Pollution Research. Proceedings*, 1971, pp. 186-200.

Examined 16 physical, chemical and bacteriological parameters of the quality of surface runoff from a small Ottawa drainage basin. Variations with rainfall duration and intensity, seasonal variations and variations due to human activity were noted. Study results indicated that BOD, suspended solids, and dissolved solids are the primary pollutants of concern from this source. It suggests that as the pollutional loadings from concentrated effluents of waste are reduced through sewage treatment, water pollution from diffuse sources becomes more problematic and more critical to the long-range preservation of the quality of an area's water resources.

Wilson, William M.C., "Environmental Planning and Management: The North Pickering Experiment", *Journal of Soil and Water Conservation*, Nov-Dec. 1976.

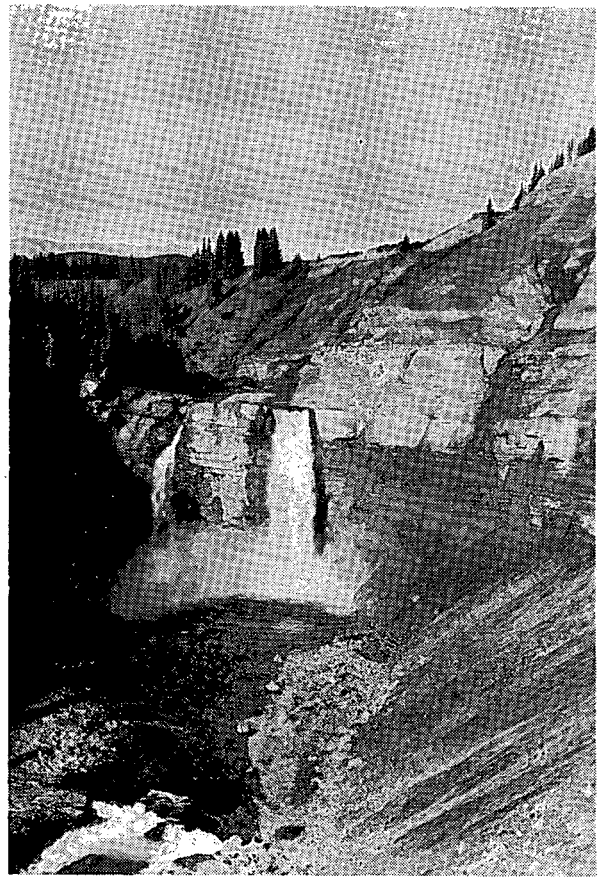
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2.4 Landforms and Soils

The subject of "landforms" and "soils" concerns the ground around us - the ground upon which we build houses, construct roads and grow crops. The term "landform" usually refers to the configuration or form of the earth's surface. Features such as a valley, a canyon or a hill are considered examples of landforms. While some landforms result because of shifts and bends in the earth's crust, others arise largely due to erosion and weathering. The wearing away of the earth's crust has lead to a loose covering – a deposit termed "soil" or more simple "dirt". For the geologist, soil applies to all the unconsolidated material which extends down to bedrock. The agriculturalist, on the other hand, has a much narrower perception as it applies more to the rooting zone of plants.



Landform and Geology

The climate and the hydrological cycle are among the natural processes which shape the surface of the land. Since these processes vary from one place to another, different forms result: flat to rolling plains, hilly to mountainous terrain, and so on. Perhaps the most important factor which determines landforms is the geologic history.

Geology includes investigations of earth materials (surficial and subsurface), earth processes, and the landforms that result from interaction between natural materials and natural processes. Geology brings to environmental planning a long time-frame. Within the perspective of the earth's several billion years of existence, for example, the last glacial ice covering of much of North America some 12 000 years ago is a recent event. Seeing the environment as a dynamic, slowly changing system emphasizes that it must be understood and accommodated by man's activities, not merely "preserved". Earth science assists in understanding the implications of short-term human modifications to the earth and its resources. It provides data for proper planning of land use, including the most effective adjustment of man's use of the earth's surface to the physical features at and below the surface. It helps identify natural hazards to human activities (e.g., earthquakes), locate mineral resources and their accessibility, determine factors that influence water supply and waste disposal, and monitor environmental change.

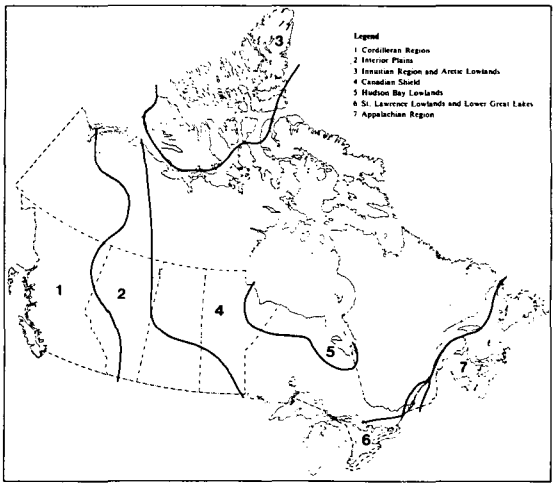


Figure 2.27 Physiographic Regions of Canada

Adapted from: Pierre Camu, E.P. Weeks and Z.W. Sametz, *Economic Geography of Canada* (Toronto: Macmillan, 1964).

The form of the Canadian land is familiar to most of us especially the broader generalizations: a saucer-shaped basin almost 3 500 miles across, sculptured by glacier ice that repeatedly covered 97% of its surface within the last million years. Every school child memorizes the names of Canada's physiographic regions: the Cordillera, the Great Plains, the Canadian Shield, the St. Lawrence Lowlands and the Appalachians. Each region has its distinctive geomorphology, pattern of relief, soil/bedrock relationship, and opportunities for and constraints to human activity. From a more detailed perspective, landforms such as hills, river terraces, flood plains and escarpments are also familiar. At the scale at which most environmental planners work, slope and relief conditions are prominent physiographic determinants of land use, development costs, and engineering and construction problems. An area's physiography is particularly significant in combination with other features, notably climate and water leading to the formation of soil.

Information Resources

B.C. Environment and Land Use Committee. *The Terrain (Landform) Classification System.* B.C. Dept. of the Environment (Parliament Buildings, Victoria V8V 1X4), 1976.

Terrain units are identified on the basis of relative homogeneity with respect to geological materials, texture, morphology and types and erosion and/or other surface processes. The system permits a wide range of interpretations. See also: K.G. Valentine et al., *The Soil Landscapes of British Columbia* (B.C. Ministry of the Environment, Resource Analysis Branch, Parliament Buildings, Victoria V8V 1X4), 1978, 197 pp.

Bird, J. Brian. *The Natural Landscapes of Canada.* Toronto: Wiley, 1972. 191 pp. $7.95.

Landforms, the individual units of a landscape, are created by the interaction of climate with rocks on the earth's surface. This book traces Canada's geologic history, discusses early glacial processes and then examines each of the major physiographic regions of Canada.

Bostock, H.S., "Physiographic Subdivisions of Canada", in Douglas, R.J.W. *Geology and Economic Minerals of Canada.* Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), 1977. 2 vols., $2.00 each.

Chapman, L.J. and Putnam, D.F. *The Physiography of Southern Ontario.* Second Edition. Toronto: University of Toronto Press, 1973. Paperback, 386 pp. $5.95.

Coates, D.R. (ed.). *Environmental Geomorphology and Landscape Conservation Vol. II: Urban Areas.* New York: Wiley, 1974. Hardcover, $25.00.

Hunt, C.B. *Natural Regions of the United States and Canada.* San Francisco, CA: W.H. Freeman and Co., 1974. 725 pp. $17.00.

Mollard, J.D. *Landforms and Surface Materials of Canada: A Stereoscopic Airphoto Atlas and Glossary.* Third Edition. Regina, Sask.: Mollard, n.d.

A teaching and reference manual that contains over 600 stereograms illustrating different Canadian landforms, landscapes and surficial deposits; includes a 2500-term glossary.

Tank, Ronald W. (ed.). *Focus on Environmental Geology.* Second Edition. New York: Oxford University Press, 1976. Paperback, 538 pp. $5.75.

A collection of readings and case studies organized in five sections: an introduction (see especially J.C. Frye, "A Geologist Views the Environment"); geologic hazards and hostile environments (volcanoes, earthquakes, mass movement, erosion and sedimentation, floods); mineral resources and the environment (future outlook for mineral resources, environmental impact of resource development); water resources; and waste disposal (including nuclear waste).

Way, Douglas. *Terrain Analysis.* Stroudsburg, PA: Dowden, Hutchinson & Ross, 1973. Hardcover, 392 pp. $29.50.

An excellent study on the classification of site and landscape types, including a rigorous landscape type classification system.

Soil/Soil Capability

Soil is a resource upon which all forms of life on land depend, directly or indirectly. Its central role in supporting and limiting human activity, and its contribution to natural system functioning and environmental change, are at the forefront of the environmental planner's concerns.

Soil is the result of complex physical and chemical weathering on the underlying rock in the earth's crust. Climate, vegetation, geology (parent material) and the geomorphic development of the landscape are all involved in the formation of soil. Its principal components are mineral particles, dead organic material, soil atmosphere (similar to our own but in different proportions), water (film on particles and free water between them) and living organisms such as fungi. Most people think of soil as the few centimetres of dirt within which plants grow (they are referring to the topsoil, the upper 15-30 cm as distinct from the subsoil below it). In fact soil is much more than that, a complex living system; a square metre of soil contains more than a billion individual forms of life. Plants give soil life and endurance as they drain nutrients from it, manufacture carbohydrates through the energy-transforming process of photosynthesis, and return dead matter to it.

Soil has a variety of properties, the significance of which depend on the use comtemplated for the soil. A structural engineer, for example, will be concerned with subsoil bearing strength, compressibility and permeability. Physical properties of soil include its texture (size and amount of mineral particles), structure (arrangement of the particles), porosity and moisture content. Chemical properties include chemical composition, organic content, colloid type and amount (which affects shrink-swell), ion exchange, retention capacity and pH. Biological properties include presence of microorganisms, animal population and plant nutrients. To an environmental planner, prominent characteristics of soil are its erodability/stability, drainage, bearing capacity and depth to bedrock and resource value.

Soil classification systems identify the range of conditions found in soil and group them into classes for ease of understanding and making use of soil properties. Classifications that describe soils and show their interrelationships are called taxonomic. Those that group soils having different capabilities for a certain purpose are called interpretive. The most recent Canadian version of the former is described in *The System of Soil Classification of Canada*, and in similar

publications in the provinces. It establishes categories (order, great group, subgroup, family, series and type) with the placement of soils in the scheme based on the properties and arrangement of horizons displayed in a soil profile (an upper horizon A of mostly organic matter, a bottom horizon C mostly parent material, and sandwiched between them a middle horizon B). The agricultural sector of the Canada Land Inventory specifically used a soil capability system.

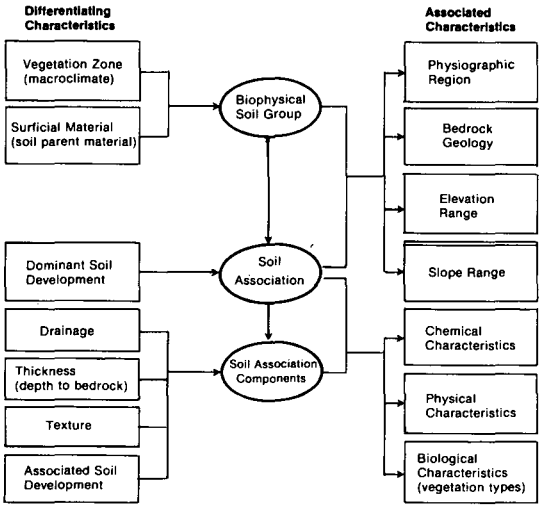


Figure 2.28 Hierarchical Biophysical Soil Classification Scheme for the Northeast B.C. Coal Area

Source: T. Vold, *Biophysical Soil Resources and Land Evaluation of the Northeast Coal Study Area 1976-1977. Volume One* (Victoria: B.C. Ministry of the Environment, Resource Analysis Branch, Dec. 1977).

Information Resources

See also:
2.1 Land Capability

American Society of Planning Officials. *Soils and Land Use Planning.* ASPO (1313 East Sixtieth St., Chicago, IL 60637), 1966. 44 pp. $2.50.

Canada. Dept. of Agriculture. *The System of Soil Classification for Canada.* The Dept. (Ottawa K1A 0C6), 1970.

Canadian Soil Survey Committee. *Canadian System of Soil Classification.* Canada Dept. of Agriculture (Ottawa K1A 0C6), 1978. 164 pp.

Falconer, A. et al., (eds.). *Physical Geography: The Canadian Context.* Toronto: McGraw-Hill Ryerson, 1974. Paperback, 314 pp. $8.95.

Section 4, "Soils and Vegetation", comprises four papers: Hoffman, "The Canadian Soils System"; James, "The Soils of the Rankin Inlet Area, Keewatin, NWT, Canada"; McKeaugue et al., "A Comparison of Luvisolic Soils from Three Regions in Canada"; and Rutherford and Sullivan, "Properties and Geomorphic Relationships of Soils Developed on a Quartzite Ridge Near Kingston, Ontario".

Gillespie, J.E. et al. *The Soils of Halton County.* Canada Dept. of Agriculture, n.d. 79 pp. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $2.00, cheque payable to Treasurer of Ontario.

An example of soil surveys available for various counties of Ontario. Includes a general description of the area, a classification of the soils of Halton County, detailed descriptions by soil series and miscellaneous mapping units, soil capability classification for agriculture and soil suitability ratings for urban and suburban use. Appendices explain the taxonomic classification and methods of chemical analysis, and provide a glossary.

Hyams, Edward. *Soil and Civilization.* New York: Harper Colophan Books, 1976 (originally published 1952). Paperback, 312 pp. $4.80.

A classic, interpreting human history from an ecological viewpoint long before that became fashionable.

Legget, Robert F. *Cities and Geology.* New York: McGraw-Hill, 1973. Hardcover, 624 pp. $21.00.

Morrison, W.D. *Report of a Detailed Urban Terrain Constraints Survey in the Urban Area of the North Pickering Planning Area.* Ontario Ministry of Housing (North Pickering Development Corporation, 950 Yonge St., Toronto M7A 2K4), April 1976. 3 volumes.

This study, part of the Ontario government's planning for a new community adjoining northeast Metro Toronto, was designed to provide stratigraphic and hydrogeologic site resources to a scale (1" = 200') suitable for detailed development planning/design work on 7 000 acres.

Soil Conservation Society of America. *Resource Conservation Glossary.* SCSA (7515 Northeast Ankeny Road, Ankeny, Iowa 50021), 1976. 63 pp. $5.00.

Soil Society of America. *Soil Surveys and Land Use Planning.* Soil Society of America (Madison, WI 53701), 1966.

Southeastern Wisconsin Regional Planning Commission. *Soil Development Guide.* SWRPC (Old Courthouse, Waukesha, WI 53186), 1969. 247 pp. $10.00. May be out of print; if so, can be borrowed from SEWRPC library.

The purposes of this extensive report were to provide an understanding of the detailed soil survey and its interpretation, to illustrate how such a survey and its analyses can be used in local/regional planning and development, and to suggest land use regulations incorporating soil survey information in order that rural and urban development might be better adjusted to the natural resource base that sustains them. Major sections describe the regional soil survey; guide its interpretation (for engineering, planning, recreational, agricultural and wildlife habitat purposes); outline the use of soils data in watershed planning as well as in neighbourhood planning, in zoning ordinances, in other land development regulations, in public health regulations, in soil and water conservation planning, and for other uses; and discuss administrative and legal considerations in the use of soils data.

Steila, Donald. *The Geography of Soils.* Englewood Cliffs, NJ: Prentice-Hall, 1976. Paperback, 222 pp. $6.90.

A recent addition to the literature of soils, this book deals with formation, distribution and management of soils. Describes the U.S. Soil Classification System in an uncomplicated fashion.

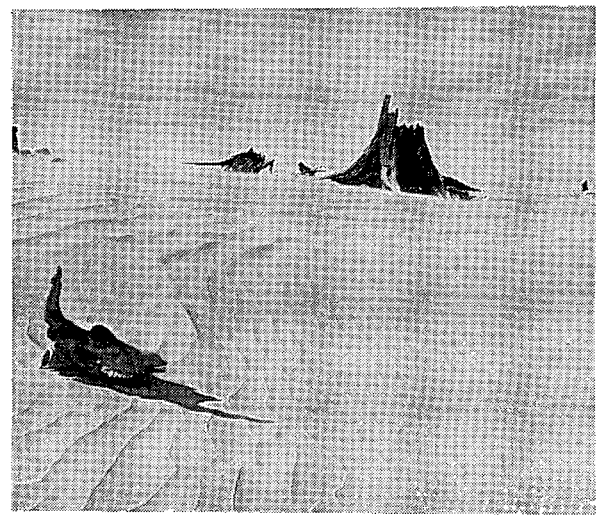
Webber, L.R. (ed.). *Ontario Soils: Physical Chemical and Biological Properties.* Toronto: Ontario Ministry of Agriculture and Food, n.d. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $1.00, cheque payable to Treasurer of Ontario.

Erosion

Erosion is the wearing away of the land surface by water, wind, ice and other geologic agents, and the transport and deposition of the weathered material. It is a natural process. A certain amount of erosion and resulting sediment are essential components of functioning natural systems (deltas at river mouths, for example).

Much erosion continues to be "natural", for instance, in maritime coastal areas where the actions of man only slightly magnify the combined effect of rising sea and an erodable shoreline. In other areas, however, man has altered this natural process by accelerating the rate and amount of erosion particularly through careless deforestation, agricultural and construction practices and by locating human activities without due regard for their erosion-creating potential. In the past the damage was done mainly in rural areas where the main effect was loss of valuable topsoil. While this problem remains, much of the erosion-related concern in Canada is no longer agricultural; it is related more to the full range of "costs" incurred when materials erode off the land, both rural and urban, into lakes and rivers. Sediment produced by erosion may contain pollutants, especially pesticides and nutrients that constitute health hazards and endanger aquatic life; accumulates in and reduces the capacity of reservoirs; restricts stream flow and increases flood hazards; increases turbid-ity which alters aquatic systems, affects fish life and increases water treatment costs; alters wildlife habitats and other valued areas such as beaches; and necessitates corrective measures (dams, channelization of streams, etc.) which are costly and which may have further adverse environmental effects.

Problems related to erosion control center on the difficulty that individuals and agencies causing erosion have in seeing the economic advantages to them of taking the necessary control measures. Erosion seems to affect someone else. Public controls bring their own problems: identifying non-natural erosion and its effects and costs, allocating responsibility to the various factors within a watershed, distributing erosion control costs between public and private sectors, pinpointing violators, and enforcing control measures. Opportunities to take corrective action lie in land use and development planning, improved and more strictly controlled practices (agriculture, construction, etc.), better information (e.g., amount, nature and sources of sediment), on-site measures such as proper use of vegetation, clearer and better organized legislation, specific controls for each class of offender, explicit examination of erosion-generated costs as part of environmental assessment, and dissemination of information on the causes, costs and minimizing of erosion.



Universal Soil Loss Equation

A = R x K x LS x C x P

- A = predicted annual soil loss, tons/acre/-year
- R = rainfall factor (reflects average annual erosion-producing rainfall)
- K = soil erodability factor (tells how easily the soil will erode)
- LS = slope length and gradient factor (L is the length and S the steepness of the slope, combined because they interact closely)
- C = cropping/management factor (takes account of type of crop, methods of tillage, etc.)
- P = erosion control or conservation practice factor.

See:
John Maddes, "Selling Conservation with the Universal Soil Loss Equation", *Soil Conservation*, April 1976, pp. 16-17, which explains the Equation in clear, simple language and demonstrates its use to environmental planners.
See also:
Truitt (Information Resources).

Case Study 22
Erosion and Siltation Study, Dunk River, P.E.I.

Submitted by Philip Wood, P.E.I. Land Use Service Centre

A detailed study has been completed on erosion and siltation on the Dunk River which flows into Bedeque Bay on Prince Edward Island. The watershed of the Dunk, almost all under monoculture, represents one of the most productive potato-growing areas in the province. Siltation from the farming activities, however, is seriously jeopardizing oyster production in the Bay.

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Box 2000
Charlottetown, P.E.I. C1A 7NB

Case Study 23
Properties Sliding into River, Owner's Plea for Aid Refused

Four Mississauga properties are reported to be gradually crumbling down a 75-foot embankment into the Credit River in Southwestern Ontario. The Credit Valley Conservation Authority and the City of Mississauga, who claim to have spent $200 000 on engineering studies in search of a solution, insist that it is up to the owners to pay $168 000 for a retaining wall and storm sewer necessary to correct the situation. The City turned down the owners' appeal for help on the grounds that (a) the City lacks a policy to deal with such situations, and (b) if it provided financial assistance in this case it would create a flood of requests from others in similar circumstances. Noting that its authority is limited to erosion caused by the river, the Conservation Authority argued that collapse of the riverbank in this case is caused by runoff of surface water. The owners, one of who pays $2 000 a year in property taxes, feel the cause is lack of a storm sewer on the street. When the houses were built 20 years ago, no setback regulations existed to prevent building too close to the river.

Source: *Globe and Mail*, 5 January 1978, p. 1-2.

Information Resources

See also:
2.3 Urban Runoff
2.4 Soil/Soil Capability

Conservation Council of Ontario and Soil Conservation Society of America (Ontario Chapter). *A Conference on Erosion — Causes, Effects, Controls.* Conservation Council of Ontario (45 Charles St. East, Toronto M4Y 1S2), 1972. 101 pp.

Proceedings of the conference including papers on: the current concern over soil erosion; erosion as a natural process; a case history of the Don Valley watershed; the environmental, social and economic impacts of erosion; engineering approaches to erosion; erosion and the municipal planning process; environmental aspects of erosion control; Iowa's legislative approach to erosion control; and summaries of workshops on agricultural erosion, bank and stream erosion, erosion from construction, and erosion and land use planning.

Environment Conservation Authority. *Erosion of Land in Northwestern Alberta — Report and Recommendations.* Alberta Environment (9820 – 106 St., Edmonton T5K 2J6), Nov. 1976. 73 pp.

Final report on public hearings, held by the Authority (now the Environmental Council of Alberta) early in 1976. The report, the culmination of an extensive process and backed by several major papers, presents a comprehensive set of recommendations on general land use and erosion in the settled agricultural area as well as on a sensitive area of the resource development fringe (Lesser Slave Lake — Swan Hills). A Regional Advisory Committee on Erosion has been established to implement many of the report's recommendations and to examine issues such as interagency coordination, demonstration plots and public education. Contact M.G. Nessman, Alberta Environment, Peace River, Alberta.

Harder, S.M. et al., "Guidelines for Mandatory Erosion Control Programs", *Journal of Soil and Water Conservation*, Vol. 33, No. 2, March-April, 1978.

Manitoba Water Commission. *Riverbanks and Shorelines: Erosion Control and Prevention, and Public Access.* Manitoba Water Commission (1445 Pembina Ave., Winnipeg R3T 2C4), Dec. 1975.

The erosion process is defined and discussed along with control methods and costs, legislation and government policy regarding erosion, and public use of shoreline and riverbanks.

Michigan Dept. of Natural Resources. *Michigan Soil Erosion and Sedimentation Control Guidebook.* Dept. of Natural Resources (Stephens T. Mason Building, Lansing, Mich. 48926), 1975.

Robinette, Gary *Plants/People/and Environmental Quality.* U.S. Dept. of the Interior, National Park Service (Washington, DC 20402). Paperback, 137 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 2405-0479, $4.00 + 25% outside U.S.A.

Erosion control through use of vegetation is dealt with briefly, pp. 33-36, and a bibliography is provided.

Soil Conservation Society of America. *Plants, Animals and Man.* SCSA (7515 Northeast Ankeny Road, Ankeny, Iowa 50021), 1973. Paperback, 272 pp. $5.00.

Proceedings of the Society's 28th Annual Meeting, 1973. Includes five papers on erosion: use of nitrogen to establish vegetation on a subsoil; vegetation to heal scars; state-of-the-art on erosion and sedimentation in the USDA southern region; impact of individual forest management practices on suspended sediment; and instructor's guide to teaching soil erosion and sediment pollution control.

Soil Conservation Society of America. *Soil, Erosion and Control.* SCSA (7515 Northeast Ankeny Road, Ankeny, Iowa 50021), 1977. 393 pp.

Proceedings of a national conference on soil erosion, May 1976, at Purdue University. Included are papers on the use of the Universal Soil Loss Equation in planning and soil erosion control.

Southeastern Wisconsin Regional Planning Commission. *Soils Development Guide.* SWRPC (Old Courthouse, Waukesha, WI 53186), 1969.

Erosion and sedimentation control are covered, pp. 145-150. Chapter IX discusses the use of soil data in soil and water conservation planning generally. Annotated further in 2.4 Soil/Soil Capability.

Truitt, Peter G. *Prediction and Control of Soil Erosion from Land Development: An Application of the Universal Soil Loss Equation in the Headwaters of the Shubenacadie River Basin.* Shubenacadie-Stewiacke River Basin Board (N.S. Dept. of the Environment, P.O. Box 2107, Halifax B3J 3B7), Feb. 1978.

The USLE is a comprehensive, widely used technique for evaluating upland erosion rates. Procedures for its application, outlined in this report, provide information necessary to (1) identify potential sediment source areas, (2) evaluate those source areas, and (3) design adequate control measures to reduce potential soil loss to acceptable limits.

Tourbier, Joachim and Westmacott, Richard. *Water Resources Protection Measures in Land Development — A Handbook.* University of Delaware (Water Resources Center, 42 East Delaware Ave., Newark, Del. 19711), 1974. 237 pp. Being updated.

Asserts that development can be accommodated on virtually any type of site without irreparable damage (including erosion) to water resources if environmental protection measures are incorporated into the development process. The need for environmental protection measures is explored. A series of fact sheets provide resource protection measures in detail. See also the companion volume: Tourbier, *Water Resources as a Basis for Comprehensive Planning and Development in the Christina River Basin*, 1973. Annotated further in 2.3 Water Quality.

U.S. Dept. of Agriculture, Soil Conservation Service. *Guidelines for Soil and Water Conservation in Urbanizing Areas of Massachusetts.* U.S. Dept. of Agriculture (Washington, DC 20250), 1975. 81 pp.

Information on conservation principles, design and construction considerations, and vegetative practices.

U.S. Dept. of Agriculture. *Proceedings of the Federal Inter-Agency Sedimentation Conference, 1963.* U.S. Dept. of Agriculture (Agricultural Research Service, Washington, DC 20250), miscellaneous publication no. 970, 1965. 933 pp.

This volume covers problems of sedimentation and techniques used to solve them.

Acknowledgements 2.5

This section includes contributions from:

George Atamanenko
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Lorne Sully
Ross Thomasson
Brian Wilkes
Paul Wilkinson
Bill Wilson

2.5 Vegetation

Climate, soil and topography determine the vegetation types, i.e. the communities of plants, native to a region. Outside the Arctic tundra, forests and grasslands are Canada's principal forms of native vegetation. On the southern Canadian plains before 1880, grass was the dominant form of cover. Agriculture, urbanization and other activities accompanying human settlement have since radically transformed that landscape. Today, prairie grass is difficult to find and various species of plant life have become rare, endangered or extinct. Although by the mid-20th century man had reduced the world's forested area by at least one-third, forests have proved more enduring in much of Canada, perhaps because their locations rendered them unsuited to the foregoing competing activities, and because they are complex systems. Forests, however, are subject to degradation and loss from man-made and natural causes. And the demands for their products are increasing.

The forest landscape represents one form of vegetation. Another is the horticultural or garden landscape, more common in urban areas. It is characterized by exotic (non-native) species, the application of aesthetic standards that stress manicured order, and emphasis on design and landscaping rather than resource management.



Information Resources

Argus, George W. and White, David J. *The Rare Vascular Plants of Alberta.* National Museum of Natural Sciences (Ottawa K1A 0M8), May 1978. 46 pp. French and English. Free.

One of a series of reports dealing with the rare vascular plants of the provinces and territories. Each rare plant in the inventory is listed by name, map location, range in North America, and its province, habitat and status; an extensive bibliography follows. A "rare" plant is one that has a small population within the province or territory, an "endangered" plant is one in danger of extirpation throughout all or a significant part of its range, and a "threatened" plant is likely to become endangered in the foreseeable future. By early 1978, similar publications existed for Ontario (June 1977) and Nova Scotia (January 1976) and were in preparation for the other provinces and territories. See also: G.W. Argus, "Canada", in G.T. Prance and T.S. Elias, *Extinction is Forever* (New York: New York Botanical Garden, 1977), pp. 17-29, which describes Canadian national and provincial legislation designed to protect rare and endangered plants and examines successes and problems. Another source, at the larger scale (where it is estimated that 10% of the total world biota may be threatened with extinction), is G.R. Long and M.A. Miasek, *Endangered Plant Species of the World and Their Endangered Habitats: A Selected Bibiography* (Library of the New York Botanical Garden, Bronx, NY 10458), 1977, $1.50.

Ferguson, Mary and Saunders, Richard M. *Canadian Wildflowers.* Toronto: Van Nostrand Reinhold Ltd., 1976. Hardcover, 192 pp. $19.95.

Presents a collection of Canadian flowers, illustrated with over 150 colour photos. Flowers are arranged into four major habitat groups and habitat characteristics are described, followed by botanical detail and everyday information for each flower.

Morton, J.E. et al. *A List of Rare or Endangered Species in the Canadian Flora – Vascular Plants.* University of Waterloo, Dept. of Biology (Waterloo, Ont. N2L 3G1), 1976.

A national listing of rare species, differing from provincial lists by the National Museum.

Forests

Canada's forests are composed largely of 31 species of coniferous trees (those with leaves that generally live on the tree for two or more seasons). Making up a fifth of the forests are 100 or so species of deciduous trees (whose leaves change colour in autumn and are shed usually before winter). The forests of Canada can be divided into nine regions based on differences of soil, climate and terrain (Figure 2.29).

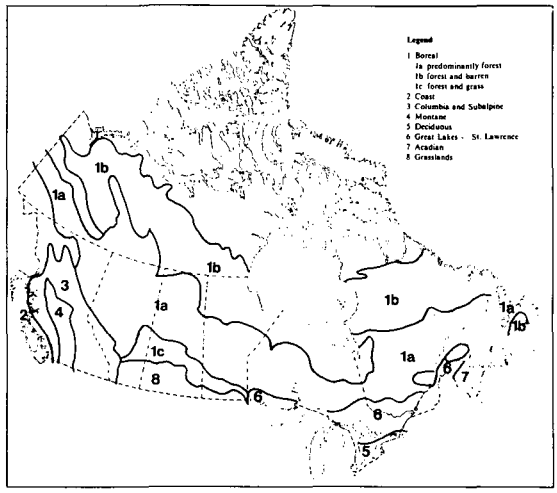


Figure 2.29 Forest Regions of Canada

Adapted from: R.C. Hosie, *Native Trees of Canada*, Seventh Edition (Ottawa: Information Canada, 1969).

The forests are among the country's greatest renewable resources, according to the Canada Year Book. Whether the resource is still renewable has come into question recently but its importance to the economy remains undeniable. The country's 800 million acres of usable forest land, 80% of which is publicly owned, provide raw material for the forest industries which account for nearly 20% of all Canadian exports. And, in many parts of the country, forest-related activities constitute *the* major influence man has on the environment.

Forests, in addition to their economic benefits, control runoff and prevent erosion, safeguard water supplies, help maintain the carbon dioxide/oxygen balance in the atmosphere, provide habitat for wildlife, and offer opportunities for recreation, education and research, and human enjoyment in general. This diversity of potential benefits, however, also creates numerous potential conflicts. A number of issues arise:

- "Integrated use", the current response to the problem of competing uses, means employing management practices to allow the resource to be used compatibly for different

purposes. But the conflicts often remain unresolved; one example is logging vs. recreation in provincial parks such as Algonquin and Lake Superior in Ontario. Unless the forest is large enough to segregate incompatible uses, further problems will arise.

- Regeneration of the forest is essential if the resource is to remain renewable. Assigning responsibility and ensuring accountability for regeneration is one problem. Another is that the owner or lessee of the forest resource may not consider it to be in his short-term interest to follow the sustained-yield concept, i.e., ensuring that new growth balances the amount removed by harvest, fire, disease and pests. Low economic return and high market risks may provide little incentive to adopt the necessary management practices. Inadequate monitoring of the extent and condition of the resource may make it difficult to determine, even where such practices are adopted, whether they are being followed.

  A further problem is that the success of the sustained-yield concept depends on how realistic the forest inventories are. Do they include only "economic" timber? Do they include ecologically sensitive areas? If much of the timber in a management unit is economically inaccessible, or if estimated cut levels are too high, the result may be "high-grade" logging which leaves only poorer timber behind. Long-term economic volumes then diminish. The problem is exacerbated if restocking practices are inadequate. In B.C., for instance, the "not sufficiently restocked" category is progressively increasing.

- Where regeneration involves genetic selection – artificially replanting or reseeding a single species – the result can be instability in the forest ecosystem. Susceptibility to pests and disease then increases.

- Natural enemies such as the spruce budworm remain even where regeneration is adequate. Totally satisfactory solutions to the pest control problem have yet to be found. Spraying raises serious health concerns, and becomes a hot political issue. It may be better to let nature do the work and to accept the economic ups and downs accompanying natural cycles.



Time Zero	2 Years Later	20 Years Later	100 Years Later	150 Years Later
Bare Field	Grassland	Grasses and shrubs	Pine Forest	Oak-Hickory Forest Climax

Figure 2.30 Field-to-Forest Succession

Source: adapted from various sources including Alden D. Hinckley, *Applied Ecology, A Nontechnical Approach* (New York: Macmillan, 1976). Succession shown here applies to the piedmont region of southwestern United States. Progress to the stable climax stage, which offers minimum maintenance and management costs but may be more vulnerable to loss of particular species, can be accelerated or retarded by management practices.

- Commercial forestry, recreation and other human uses of the forest resource can have adverse environmental effects, such as water and air pollution from pulp and paper mills, clearcutting, road construction, and effects of tracked vehicles and heavy recreation use. Conversely, public concern over possible environmental impacts may block an action which, from the forestry industry viewpoint, is needed to maintain productivity of the resource.

- In areas such as the Maritimes the forest resource is fragmented among numerous small woodlot owners and, more recently, summer cottage owners. While this may have certain advantages, it also seriously affects economic harvesting of the resource.

An underlying factor may be the general lack of public information on and input to government decisions affecting the forest industry. Environmental impact assessment is a step in this direction but so far it affects few decisions overall. If the outcome is confrontation late in the decision process, complex issues are liable to boil down to a simplistic choice, jobs vs. environment, with few tradeoffs possible. The environment then comes out second best.

Case Study 24
Budworm Program in Nova Scotia

The federal government has approved spending of nearly $16 million in Cape Breton over the next four years to salvage and store pulpwood damaged by spruce budworm infestations and to test new approaches to reforestation and silviculture in western forests affected by the budworm. The new program supplements an earlier federal-provincial development agreement, with the Province financing 20% of the cost. An estimated 3 million cords of softwood face high risk in the Cape Breton area because of spruce budworm damage.



Case Study 25
Tsitika Watershed Planning Study, Vancouver Island
Submitted by Brian Wilkes

The Tsitika River watershed is the last remaining unlogged watershed on the east coast of Vancouver Island. Jurisdiction over the resource is divided between the B.C. Forest Service (a provincial Governmental agency) and the Land Management Branch, Ministry of the Environment. Wildlife and Parks agencies, who want the watershed preserved for baseline ecological studies, cite its value for large and small mammals, fisheries, recreation and continued functioning of the forest ecosystem.

The resulting conflict with forest resource interests led to the establishment of a committee to plan the optimum extraction of the timber. Initially, representation on the committee was heavily weighted to forest interests but public pressure resulted in the appointment of three representatives from other user groups (hunters, recreationists and naturalists). The committee, however, is constrained by its terms of reference – it was not given the option of rejecting logging – and by the strongly political nature of the issue. Public input to the committee is hampered by lack of information, and constraints placed upon provincial civil servants limit their participation.

The committee's work is continuing. The key output, its report together with a cutting plan, is expected in August 1979.

Contact:
Ed Mankelow
Chemainus, B.C.
(604) 246-3109
(Private citizen representing Sierra Club, B.C. Wildlife Foundation, Federation of Mountain Clubs, Federation of B.C. Naturalists)

Information Resources

B.C. Ministry of Forests. *Tree Book.* B.C. Ministry of Forests, Forest Service Information Division (10-525 Superior St., Victoria V8V 1X5), March 1977. Paperback, 99 pp. One copy free; additional copies $1.00.

Aimed at a popular audience, this attractive little book provides the average B.C. resident with a quick, easy and interesting method of tree identification along with background information on the tree's uses, location and history. Part of a series which includes *Forestopics* (fact sheets on forest management), *The Renewable Resource* (on the concept of integrated resource use forest management) and several attractive posters. The Department also issues a quarterly magazine, *Forestalk.*

Bell, M.A.M. et al. *Impact of Harvesting on Forest Environments and Resources.* Environment Canada, Forestry Service (Ottawa K1A 0H3), Technical Report 3 with Supplement No. 1, 1975.

Dixon, R.M. *The Forest Resources of Ontario.* Toronto: Ontario Dept. of Lands and Forests, 1963 and 1971. 107 pp. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $0.75.

"Environmental Impact Assessment in Forest Ecosystems", *Forestry Research Newsletter,* Autumn, 1977. Available from Environment Canada, Forestry Service (Ottawa K1A 0H3).

Describes the Great Lakes Forest Research Centre's environmental impact project. Initiated in 1972, the project is aimed at: (a) documenting the impacts of major man-induced disturbances on forest ecosystems in Ontario, and gathering baseline data on conditions prior to disturbances, and (b) recommending and developing ecologically sound management alternatives to and corrective measures for impacts that appear to be detrimental to the ecosystems involved. Impacts examined so far include: clearcutting, scarification and road building as they affect productive capacity of the land and quantity/ quality of surface runoff from forest waterbeds; intensive recreation in parks (relationships between use, soil composition and cover); long-range transport of atmospheric pollutants (see 2.2 Air Quality); and vegetation-habitat changes caused by linear constructions such as roads, pipelines and powerlines. Further information is available from Great Lakes Forest Research Centre, Environment Canada (P.O. Box 490, Sault Ste. Marie, Ont. P6A 5M7).

Gane, M., "Nature Conservation in Relation to a National Forest Policy", *Forestry,* Vol. 219, No. 7, 1976, pp. 91-98.

Harcombe, Andrew. *Vegetation Resources of the Northeast Coal Study Area, 1976-1977.* B.C. Ministry of the Environment, Resource Analysis Branch (Parliament Buildings, Victoria V8V 1X4), March 1978. 45 pp. Free.

This report is the first study to be published using the Resource Analysis Branch's vegetation classification system. It serves as the basis of a wide range of interpretations (including agriculture, forestry, wildlife, recreation, aesthetics and engineering) in the Northeast B.C. Coal Block. The report, does not provide these interpretations, however, they are available upon specific request from the Assistant Director of the Resource Analysis Branch.

Hosie, R.C. *Native Trees of Canada.* Seventh Edition. Ottawa: Environment Canada, Canadian Forestry Service, 1969 (reprinted 1975). Paperback, 380 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $6.00.

Canada's nine forest regions are defined. The species found in each are then illustrated and described in turn according to form, habitat, size, leaves, cones, twigs, bark, wood, seedlings and importance.

Hough Stansbury & Associates. *Design Guidelines for Forest Management.* Toronto: Ministry of Natural Resources, n.d. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $15.00, cheque payable to Treasurer of Ontario.

A manual, aimed at the forest manager. Organized in three sections: planning for management; forest management (site protection and aesthetics for roads, cutting, reforestation, utilities, interpretation and recreation); and special areas.

Jones, L.A. *Forest Environmental Resource Planning: A Selected Bibliography and Guide to the Literature.* U.S. Army Corps of Engineers, Walla Walla District, 1977. U.S. Army Corps of Engineers (Washington, DC 20314), 1977. 158 pp. $12.50.

Love, Peter and Overend, Ralph. *Tree Power: An Assessment of the Energy Potential of Forest Biomass in Canada.* Dept. of Energy, Mines and Resources, Renewable Energy Resources Branch (Ottawa K1A 0E4), 1978. 53 pp.

Annotated in 2.7 Energy.

Lynch, J.A. et al., "Implication of Forest Management Practices on The Aquatic Environment", *Fisheries* 2(2), 1977, pp. 16-22.

Manning, G.A. and Grinnell, H.R. *Forest Resources and Utilization in Canada to the Year 2000.* Environment Canada (Ottawa K1A 0H3), 1971.

Ministère des terres et forêts. *Guide d'aménagement du milieu forestier.* Québec Ministère des terres et forêts, Groupe de planification sectorielle (2700 Einstein, Ste-Foy, P.Q. G1P 3W8), 1977. 158 pp.

This "Forestry Management Guide" defines the work of the forester. The five chapters cover broad measures of forest management. Then more specifically, management principles and practices are described with respect to the forest resource, water, wildlife and recreation.

Pearse, Peter H. *Timber Rights and Forest Policy in British Columbia, Vol. 1.* B.C. Ministry of Forestry (Parliament Buildings, Victoria V8V 1X5), 1976.

Makes recommendations on all matters relating to the disposition of rights, by the Crown, to harvest timber and occupy forested land in British Columbia.

Potvin, Albert. *A Panorama of Canadian Forests.* Ottawa: Environment Canada, Canadian Forestry Service, 1975. Hardcover, 254 pp. Available from Nature Canada Bookshop (75 Albert St., Ottawa K1P 6G1). Hardcover, $13.50.

Handsome photo-essay on the origins and history of Canada's forests, their relationships to other forests of the world, their composition, the biological responses of trees to different environments, and forests of the future.

Reed, F.L.C. and Associates Ltd. *Forest Management in Canada – Volume I.* Environment Canada, Forest Management Institute (396 Cooper St., Ottawa K1G 3Z6) Information Report FMR-X-102, 1978. 155 pp. *Forestry Management in Canada – F.L.C. Reed and Associates Ltd. – Summary.* Information Report FMR-X-104, 1978. 55 pp.

This report improves the basis for policy formulation, planning and practice in forest management. Forest management in each province is described and a set of guidelines for forest management in Canada is given.

Rowe, J.S. *Forest Regions of Canada.* Environment Canada, Forestry Service (Ottawa K1A 0H3), Publication

No. 1300, 1972. Paperback, 171 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9). $2.50.

Sarrazin, Raymond (éd.). *Effets environnementaux des pulvérisations aériennes contre la tordeuse des bourgeons de l'épinette au Québec – 1977.* Ministère du tourisme, de la chasse et de la pêche, Direction de la recherche faunique (9530 rue de la Faune, Orsainville, Qué. G1G 5E5), novembre 1977. 31 pp.

A preliminary report on the environmental effects of spruce budworm spraying.

Soil Conservation Society of America. *Plants, Animals and Man.* Soil Conservation Society of America (7515 Northeast Ankeny Rd., Ankeny, Iowa 50021), 1973. Paperback, 272 pp. $5.00.

Proceedings of the Society's 28th Annual Meeting, 1973. Included are papers on: plant resources; functional aspects of resource; conservation affecting plants, animals and man; and plants, animals and man – meeting society's needs. Other papers cover air resources, land use planning, water and fish/wildlife resources, soil resources, waste management, erosion and sedimentation, outdoor recreation and conservation/environmental education.

Stone, Christopher D. *Should Trees Have Standing? Toward Legal Rights for Natural Objects.* New York: Avon/Discus Books, 1975. Paperback, 118 pp. $1.50.

The author argues, in the United States context, that the concept of legal standing has been expanded over the years to include groups whose rights were once considered dubious (women, Blacks, Indians, prisoners, etc). He explores the implications of extending legal rights to natural objects. His concern is not whether a tree should have the same rights as a human being, but whether it should be able to be represented in court by legal counsel, as corporations are.

Walmsley, M.E. and Von Barneneld, J., "Biophysical Land Classification Techniques: The Application to Ecological Classification of Forest Land in British Columbia", in *Proceedings, Ecological Classification of Forest Land in Canada and Northwestern U.S.A., Sept. 30-Oct. 2, 1977, Vancouver, B.C.* University of British Columbia, Centre for Continuing Education (Vancouver V6T 1W5), 1977, pp. 41-120.

Urban Vegetation

Vegetation in urban areas has been looked upon largely as an amenity, almost an ornamental resource. But trees, vines and other kinds of vegetation are being increasingly recognized for the wider range of values they have for urban and near-urban environments. Vegetation enhances environmental quality and performs the vital functions of direct and indirect benefit to human settlement:

Air conditioning. Plants do some of this by removing a certain amount of carbon dioxide and other pollutants from the air (but see Hagevik), by releasing oxygen and by trapping dust and releasing moisture. (To be fair, especially to allergy sufferers, it should also be noted that plants can add pollutants to the air, especially in the form of pollens and contribution to smog.)

Microclimate modification. Vegetation influences air temperature, humidity and wind. If properly located and of the right kind, trees can moderate heat through their shading effect and the process of evapotranspiration, and they can act as buffers against the wind and snow. In both cases, energy savings can result.

Water retention. Trees and other plants help maintain the quantity and quality of water by aerating and holding together the soil, thereby increasing its capacity to absorb water. Where a watershed for public supply is involved, the presence of vegetation becomes especially significant.

Erosion control. Plants effectively reduce water and wind erosion. Their leaves, branches, roots and litter stabilize slopes, diminish the washing away of soil into watercourses, and reduce the pollution that would otherwise result.

Habitat. Vegetation provides habitat for valued wildlife even in urban areas. Often a major difference between a new subdivision and a mature area is that the latter has had time to develop groves and corridors of vegetation, especially in backyards which are home to songbirds and other forms of life.

Noise attenuation. Depending on species, the height, density and location of vegetation has been found to play a useful role in buffering residential areas from noise sources. It is easy to exaggerate this positive effect, though. Buffers may reduce perceived noise and complaints (we complain less about what we can't

see) but it takes a substantial depth of trees to reduce actual noise levels appreciably.

Visual barriers and screening. Plantings surrounding disagreeable sights or between unrelated land uses can add a desired element of privacy. They can also screen or soften the glare and reflection from a glass-and-concrete urban environment.

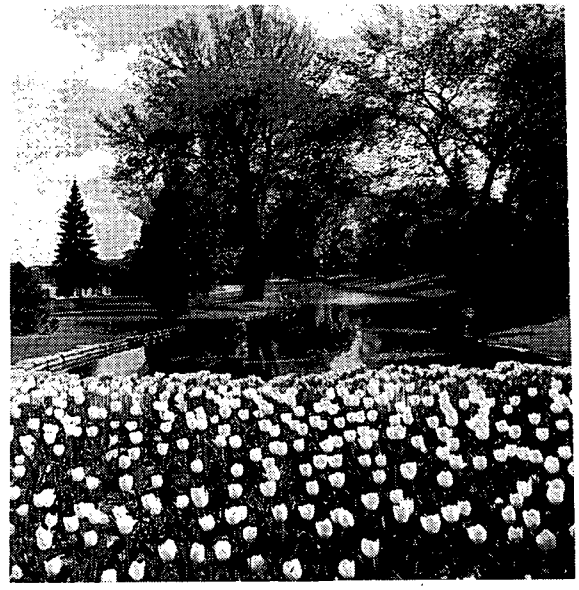
Aesthetic benefits. Vegetation can enhance man-made development of all kinds, thereby improving visual quality, enjoyment of use and property value.

Other social benefits. Trees are believed to provide sensory diversity and awareness of changing seasons, reduce vandalism, and increase public use of urban parks. Trees have educational value. And for most people, they contribute to a sense of wellbeing.

Despite its numerous promised benefits, urban vegetation is under constant threat and much of it is continually being lost. For example, in resource and other outlying settlements, vegetation may represent a fire hazard, necessitating construction of fire breaks. When some trees are removed, however, those that remain are more exposed to stronger winds and may not be sufficiently wind-firm to remain standing (which makes them hazards to public safety, and so on). In newly urbanized areas, much of the threat to vegetation has to do with attitudes of developers and homeowners. Saving existing trees is difficult and often costly. It may be much easier to remove the vegetation, then replace it with new trees after construction is complete; this overlooks the diversity and habitat that is lost, and the fact that it takes many years to replace mature trees.

In existing urban areas, factors affecting growth and survival of vegetation include (and these vary by species and location):

Oxygen and moisture starvation. Water and/or oxygen supplies to vegetation are disrupted by paving, ground compaction which reduces the amount of oxygen which reaches the roots and inhibits respiration and root growth, the lowering of the water table, and the raising of the elevation around trees. Soil percolation rates are slowed and moisture is prevented from reaching the soil. Poor maintenance of street trees similarly contributes to the loss of planted species.



Chemical deficiencies. Plants require a continuous supply of nutrients from the soil and the air. Nature's nutrient recycling process is disrupted when human activities remove organic material from the soil and fail to replace it or when they degrade the quality of the air.

Light deficiency. Large urban buildings create huge shadows that cut off light to affected plants. Suppression of photosynthesis results in stunted or uneven growth.

Pollutants. Urban vegetation is affected by road salting operations, heavy metals (especially from automobile emissions), industrial pollution (notably SO_2 and HF) and pesticides (e.g., when weed control exceeds its mandate).

Mechanical injury. Construction activity is the main culprit. Others include vandalism and other deliberate acts of destruction, excessive use through play activities, damage from mowing and snow removal equipment, over-zealous pruning, fires and storms.

Deliberate removal. In most municipalities, owners need no permission to remove trees on their property; much vegetation is lost in this way. Conflict between public works officials and those responsible for trees, the former concerned that trees may inhibit street cleaning or damage underground utilities, can also lead to vegetation loss.

Vegetation protection in newly developing areas can be achieved through careful selection of spe-

cies (using vegetation with known tolerance to local urban conditions), planning, environmental management and negotiations with property owners. In existing areas the emphasis must be on identifying vegetation resources, working out problems and conflicts, and ensuring replanting where required. In both cases there is a need for ongoing monitoring programs to keep track of the state of the vegetation resource: how many species, of what kind, where, in what condition, and at what extent of loss. It is not a common approach. And therefore, in every municipality there are at risk unique pictures of living history, some of the oldest and largest living things in the world, examples of an array of ecological situations and successional patterns, and habitats for valued wildlife.

Table 2.12 Vegetation Parameters for Consideration in Environmental Planning and Impact Assessment

Class	Parameter
Amenity	Visual quality Recreational potential Noise abatement Air pollution reduction Climate amelioration Historic value
Human safety	Fire potential Windthrow and breakage potential
Ecological	Indicator of environmental condition Erosion control Wildlife habitat Role in the regional ecosystem Succession potential Fragility
Economic	Commodity resources Tax revenues
Scientific	Rare and endangered species Unique vegetation types Gene composition

Source: J.R. McBride, "Evaluation of Vegetation in Environmental Planning", *Landscape Planning* 4 (1977), pp. 291-312.

Case Study 26
Buzz-Saw Bandits Making Off With Developer's Trees

Reprinted from *Mississauga News*, 7 Aug. 1978 (emphasis added)

Peel Regional Police yesterday were called in to help protect a stand of mature trees which have in the past week been mysteriously disappearing, one by one. The trees have been marked with red crosses for preservation but up to yesterday six 40-footers had been cut down and carted away.

Doug Hanson, spokesman for Urban Equities Ltd., the owner of the land which is being developed as a subdivision known as Sherwood Meadows, said yesterday that he was asking police to step up patrols in the area to stop the trees being stolen. The development is on the north side of Burnhamthorpe Road. at the west end of Rathburn Road. Hanson said his company has agreed to preserve as many trees as possible and many have been marked for protection. City Hall has also designated the area as a limited environmental protection area. Hanson said the company is concerned about the missing trees and wants their disappearance stopped. He said it seems that *people see development going on at the site and assume that the trees are there for taking.* Councillor Larry Taylor says he is angry about the removal of the trees and that he hopes that anyone in the area who hears chain saws at night or on the weekend will immediately contact police.

Dirk Blyleven, the city's principal environmental planner, said yesterday that the city wants the trees preserved but has no power to ensure that because they are on private property. He said the developer has agreed to save as many trees as possible and has been very cooperative. "The municipality, though, has no jurisdiction over the protection of trees on private property", he said, "Yes, we are very concerned about this incident". He said city council has tabled a proposed tree bylaw designed to protect trees on private property. Under the bylaw, a developer would make cash deposits of $200 to $300 per tree and if any went missing he would lose his deposit.

Case Study 27
"Communitree Planning" in North Pickering, Ontario

North Pickering is a new community (planned population of 75 000) being developed by the Ontario Government on a 25 000-acre site adjoining northeast Metro Toronto. The project encompasses three major land use zones – urban, agricultural and a peripheral parkway belt. From the outset, planning emphasized the conservation of natural and historical features of merit.

The urban forestry component includes seven steps:

1. *Inventory* of existing wooded and wildland resources.

2. *Classification* of wooded areas in terms of site type, forest cover type, forest use class and ecological diversity.
3. *Evaluation* of each wooded area to show integrated value for given purposes (e.g., tolerance to human impact, potential for urban woodland park).
4. *Planning* to preserve unique and particularly valuable natural areas and to conserve areas as inter-community linkages with ready-made landscaping.
5. *Protection* and continual surveillance to assure survival of these natural resources during the long period of land assembly, planning and development.
6. *Implementation* of continuing resource improvement programs begun as soon as the land was acquired and the preliminary development framework was decided, including planting seedlings (slope erosion control, conservation of watercourses, etc.), stockpiling shade trees for later landscaping, improvement of wooded areas (e.g., removing unsightly dead elms) and construction of a hiking trail system.
7. *Coordination*, i.e., constant liaison with the various agencies and interests involved.

Three years after the urban forestry program was begun, the aims appear to have been met.

Source: Keith W. Horton, "Of Trees, Natural Ecosystems and Community Design", *Plan Canada*, 16/3, Sept.-Dec. 1976, pp. 208-212.

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Information Resources

See also:
2.5 Forests
3.6 Environmentally Sensitive Areas
3.7 The Rural-Urban Fringe
4.2 Urbanization

Andresen, John, W., "Legislation to Enhance and protect Canada's Urban Trees and Forests", in Wiken, E.B. and Ironside, G.R. (ed.). *Ecological (Biophysical) Land Classification in Urban Areas. Proceedings of a Workshop, Canada Committee on Ecological (Biophysical) Land Classification, 23 & 24 November, 1976, Toronto.* Ottawa: Environment Canada, 1977. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $4.00.

Discusses the need to conserve urban vegetation and the limits of Canadian law in relation to urban vegetation, then reports the results of a survey of tree management policies and practices at the municipal level in Ontario. Of the 399 municipalities who responded, representing 90% of Ontario's population, the following proportion indicated they had taken an inventory of "public" trees: 26.5% of 34 cities and boroughs, 2.5% of 80 towns, none of the 56 villages, less than 1% of 207 townships and 13.6% of 22 "upper tier" municipalities, for an overall average of only 17% of all municipalities.

Davis, Donald D. and Wilhour, Raymond G. *Susceptibility of Woody Plants to Sulfur Dioxide and Photochemical Oxidants.* U.S. Environmental Protection Agency (Corvallis Environmental Research Laboratory, 200 S.W. 35th Street, Corvallis, Oregon 97330), 1976.

Dorney, Robert S., "Re-creating the Early Ontario Landscape in a Front Yard", *Landscape Architecture*, Oct. 1975, pp. 420-423.

The author describes how he conceptualized a miniature ecosystem containing seven symbolic Ontario environments – Great Lakes shoreline, Canadian Shield, boreal forest, oak plains, Niagara escarpment, maple and beech forest, and Carolinian forest; proceeded to design the ecosystem for a 32′ x 60′ area on his suburban lot in the Waterloo area; and created a mini-forest (heritage garden) of some 125 species over four years.

Gold, Seymour M., "Social Benefits of Trees in Urban Environments", *International Journal of Environmental Studies*, Vol. 10, 1977, pp. 85-90.

Goodwillie, R. and Cabot, D., "Plants as Indicators of Environmental Change", *Nature in Focus*, 14, pp. 7-8.

Describes the concept of indicator species and the manner in which the appearance of certain species or the disappearance of others can reflect changing conditions brought on by some disturbance.

Hagevik, George et al. *The Contribution of Urban Planning to Air Quality.* U.S. Environmental Protection Agency (Office of Air and Waste Management, Research Triangle Park, N.C. 27711), 1974.

Reports briefly (pp. 5-8 to 5-9, with various backup references) on the utility of vegetation as a pollutant absorber. Conclusions: the literature is sparse and the results inconclusive. Generalizations about the usefulness of vegetation in absorbing pollutants are difficult to make because of the complexity of interrelated variables such as type of vegetation and density required, pollutant type and concentration, and seasonal variations. Studies suggest that trees, especially conifers, remove certain aerosols, particulates, ozone and gaseous pollutants from the atmosphere without damaging the tree (within limits) but the amount is uncertain.

Harper, David and Chaster, Gerry. *Vegetation and Development.* Corporation of the District of Saanich (770 Vernon Ave., Victoria, B.C. V8X 2W7), 1976, 35 pp.

A booklet, prepared jointly by the Parks and Planning Departments of the municipality, to encourage the preservation of vegetation during development. It provides useful information on site selection/design and on effective measures for preserving trees and other vegetation in the pre-construction, construction and post-construction phases of urban development. The municipality is currently attempting to devise a tree cutting bylaw which would (a) seek to estimate the value that trees on private property have to the community, and (b) impose that value as a fee if the owner cut down the tree.

Hepting, George H., "Air Pollution and Trees", in Matthews, W.H., et al. (ed.). *Man's Impact on Terrestrial and Oceanic Ecosystems.* Cambridge, MA: MIT Press, 1971. Hardcover, $25.00.

Horton, K.W. and Wilson, W.M.C. *Choosing the Right Tree for Various Urban Settings.* Ontario Ministry of Housing, North Pickering Project (950 Yonge St., Toronto M7A 2K4), April 1975. Unpublished draft, 8 pp.

The authors could find no single source providing a compendium of pertinent information that would allow an urban landscape designer to best match a specific tree to a specific site. This paper is an attempt to do so for a particular area, the North Pickering new community site adjoining northeast metro Toronto. Species covered are those presently on the 25 000 acre site; since these species are for the most part common throughout Ontario, however, the information has wider relevance.

International Union of Forestry Organizations. *Trees and Forests for Human Settlements.* University of Toronto, Centre for Urban Forestry Studies (c/o Faculty of Forestry and Landscape Architecture, 203 College St., Toronto M5S 1A1), 1976. $5.00.

A collection of over 40 papers from an international conference on urban forestry.

Jones, A.R.C. et al., "Un concept de forestaire urbain", *Milieu*, 1976, 12:52 pp. (publié par Environnement Canada, Centre de recherches forestières des Laurentides, Québec).

Discusses the concept of urban forests and the problems of establishing and maintaining them.

Keyes, Dale L. *Land Development and the Natural Environment: Estimating Impacts.* The Urban Institute (2100 M. St. NW, Washington, DC 20037), 1976. 128 pp. $4.95.

Vegetation is included in Part 3 (value, methods of measuring quantity/quality, estimating future conditions, recommendations for the planner).

McBride, J.R., "Evaluation of Vegetation in Environmental Planning", *Landscape Planning*, 4 (1977), pp. 291-312.

Reviews the characteristics of vegetation evaluated in environmental planning and impact assessment, especially in areas of urban expansion. A checklist of 19 vegetation parameters grouped into five classes (amenity, human safety, ecological, economic, scientific) is suggested as a basis for making a more comprehensive analysis of vegetation. A vegetation survey method for planners, aimed at evaluating these parameters, is developed and the relationship of each vegetation parameter to proper environmental planning is discussed. An extensive bibliography is included.

Oemichen, Friedrich. *Méthode d'évaluation du potentiel récréatif des forêts urbaines de la région métropolitaine de Montréal.* Université de Montréal, Département de l'architecture du paysage (Case postale 6128, Succursale A, Montréal, Qué. H3C 2J7), April 1975.

Planning principles, criteria and methods for the evaluation of forested areas in cities are provided.

Ontario Shade Tree Council. Information Sources Brochure. OSTC (7241 Jane Street, Concord, Ont. L4K 1A7), 1978. $5.00 per 100 copies.

Comprehensive listing of agencies, organizations and reference materials available to assist citizens and municipal governments concerned with conserving and managing Ontario's trees, forests and related green spaces. Included are references related to urban environmental issues, ornamental horticulture and grounds maintenance.

Regional Municipality of Hamilton-Wentworth, Planning and Development Dept. *Greening of Hamilton-Wentworth (Value of Trees in Urban Areas).* The Dept. (City Hall, Hamilton, Ont. L8N 3T4), 1975. 16 pp. Free.

"It is significant that the problems in our urban environment are not the lack of concrete facts concerning the beneficial characteristics of vegetation, but rather the 'dissemination' of these facts. Thus it is the purpose of this document to present in a clear, concise manner some of the beneficial characteristics of vegetation in the urban environment and present them in a readily available, easily comprehendable format". Includes environmental and ecological benefits, social and aesthetic benefits, and economic benefits.

Robinette, Gary O. *Plants/People/and Environmental Quality.* Washington, DC U.S. Dept. of the Interior, National Park Service, 1972. Paperback, 137 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 2405-0479, $4.00 + 25% outside U.S.A.

". . .contemporary environmental designers and planners have generally ignored plants and made little or no serious provisions for their use in large-scale planning, because of the 'gardenesque' stigma carried over from earlier eras". The author describes the symbolic and functional values of plants, then makes a strong case for using plants not merely for beautification but to solve environmental problems. Architectural, engineering, climate-control, aesthetic and other uses of plants are elaborated in a handsomely presented text. An extensive bibliography is included.

South Central New York Resource Conservation and Development Area. Urban *Forestry Program.* New York State Dept. of Environmental Conservation (Box 594, Sherburne, NY 13460), 1972. 16 pp.

This program is an attempt to preserve remaining healthy trees and to formulate sound planting replacement programs in urban areas. A forester with the RC & D works with groups of interested people to supply expertise in formulating urban forestry plans and carrying out projects (by these groups and their local municipalities). This report describes the program, lists ten criteria for organizing and implementing an urban forestry or shade tree program, outlines the value of trees in urban areas, tells how to conduct inventories, discusses jurisdictional problems, provides some instructions for selecting trees, and discusses maintenance. For further information, contact William L. Betts, Senior Forester, NYSDEC.

Sudia, Theodore W. *The Vegetation of the City.* U.S. Dept. of the Interior, National Park Service (Washington, DC 20204), n.d. 17 pp. Free.

One of a number of booklets in the urban ecology series. Expresses public sentiment well, e.g., "For most people the vegetation of the city is for ornamentation. We like it because it is beautiful, pleasing and aesthetic. The vegetation of the city gives us a feeling of well-being, a feeling that we are in harmony with our environment."

2.6 Wildlife and Fish

Acknowledgements 2.6

This section includes contributions from:

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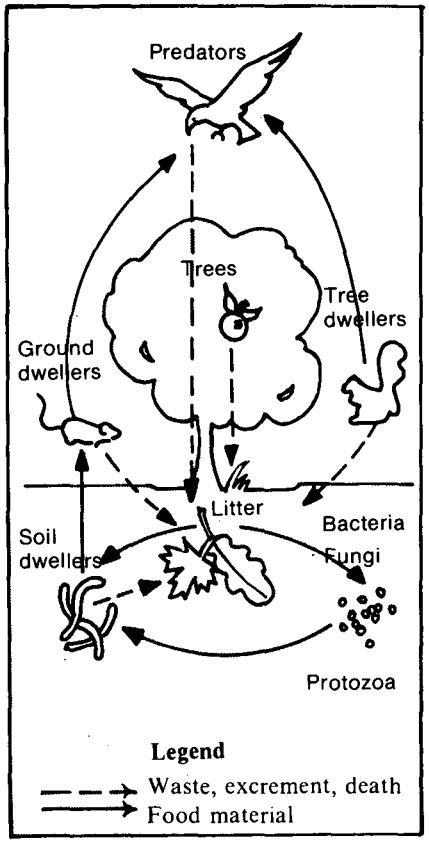
Wildlife is often taken to mean all undomesticated vertebrate animals, excluding fish, living in a given area, whether they are considered beneficial or not. Another definition, more narrowly anthropocentric but at the same time more easily employed, limits wildlife to those nondomestic animals large enough to be seen and appreciated by man.

Wildlife is unlike other resources. Its monetary value is not easily demonstrated, especially in urban and urbanizing areas. In rural areas wildlife management has been directed mainly at the production of game (hunters paid the bills through licenses, taxes, etc. and they called the tune), to a lesser extent at maintenance of trapping and hunting for commercial purposes, and at public protection against hazards such as bears. Recently there has been a growing movement toward conservation of wildlife for purposes of enjoyment other than hunting or sport fishing; the aim is to conserve wildlife for the pleasure man derives from it for its own sake. More action has also been taken to protect endangered species and threatened habitats, create ecological reserves, restore habitats and undertake management of non-game wildlife. Few would argue, however, that these actions are adequate. And in some cases – whaling, for example – the concern is that "conservation" actions being taken are destructive.



Fish, as a resource, share most of the problems of wildlife. To a greater extent than wildlife the fishery has commercial value as a significant food source, domestically and for foreign trade (unfortunately half of this valuable protein goes into pet food), and for sport fishing related to tourism. However, the fact that "relatively little is known about the distribution, taxonomy, ecology and behaviour of nearly all non-food and non-sport fishes in Canada" (McAllister and Gruchy, in Mosquin and Suchal, 1977) reveals the true meaning of "resource" as applied to fish. Various human activities, particularly those affecting the key habitat requirements (water clarity, water temperature, oxygen, absence of toxic chemicals, waterside vegetation, shelter, type of bottom, etc.) and the introduction of exotic species such as carp have affected fish life adversely in Canada. Of our native fish fauna, at least two species are extinct in Canadian waters, nine are on the edge of extinction, six are threatened and likely to become endangered, and nineteen are so rare they could easily be wiped out. Seven of the thirty-six are unique to Canada and are found nowhere else in the world.

Nonurban wildlife management has been usefully related to management of the forestry and fishery resources. Comparable relationships have yet to be worked out with urban planners, through ecologists, landscape architects and urban foresters, or directly with citizen groups (such as field naturalists clubs) building on the interest many urban property owners have demonstrated in creating backyard conditions favourable to birds and other wildlife. Habitat – that place where the needs of a species for food, water, cover and reproduction sites are met – is the key to wildlife and fish protection. Where habitat exists sooner or later there will be an occupant. Moreover, the number, kinds and diversity of wildlife may be a reflection of the long-term suitability of that habitat for man. The extent to which wildlife and fish continue to survive depends largely on the control of environmental contamination and on wise land planning.



Food chains are the pathways by which living organisms obtain, use and transfer energy. Preserving wildlife, for example, involves not only individual species but also a recognition of key relationships among them within their environments.

Figure 2.31 Food Chains

Source: Reg Lang and Audrey Armour, *Oakville Environmental Report: A Case Study in Environmental Planning* (Toronto: Lang Armour Associates, 1977).

Information Resources

See also:
2.6 Urban Wildlife
3.6 Environmentally Sensitive Areas

Banfield, A.W.F. *The Mammals of Canada.* Toronto: University of Toronto Press, 1974. Hardcover, 438 pp. About $25.00.

Richly illustrated book that describes mammals in detail including their phylogenetic relationships, physical characteristics, habits, reproductive patterns, economic importance and geographic distribution.

B.C. Ministry of the Environment. *Wildlife Resources of the Northeast Coal Study Area, 1976-1977.* Ministry of the Environment, Resource Analysis Branch (Parliament Buildings, Victoria V8V 1X4), 1977. 58 pp.

Prepared by the Resource Analysis Branch, Ministry of the Environment, in collaboration with the Fish and Wildlife Branch of the Ministry of Recreation and Conservation, this report attempts to evaluate the possible impacts of coal mining and related developments on wildlife, primarily big game. It includes a preliminary economic analysis of "consumer surplus" values (i.e., those not paid for) and non-consumptive values (social, scientific, aesthetic, recreational) in relation to wildlife. See also: Pearse-Bowden Economic Consultants, *The Value of Resident Hunting in British Columbia*, Study Report No. 6, B.C. Ministry of Recreation and Conservation, Fish and Wildlife Branch (Parliament Buildings, Victoria, B.C.), 1972; Quadra Economic Consultants, *Fish and Wildlife in British Columbia – A Review of Resource Values*, Study Report No. 7, B.C. Ministry of Recreation and Conservation, Fish and Wildlife Branch, 1977, a province-wide review of values including a method for estimating the value of non-consumptive uses; and A. Luckhurst, *Guidelines: Land Capacity Classification for Wildlife (Ungulates)*, B.C. Ministry of the Environment, Resource Analysis Branch, Sept. 1975, unpublished draft, which attempts an estimate of ungulate carrying capacity and which provided the basis for the wildlife resource report, above.

Benson, John, "Hog in Sloth, Fox in Stealth: Man and Beast in Moral Thinking", in Peters, R.R. (ed.). *Nature and Conduct.* New York: Macmillan, 1975.

Explores, especially in children's literature, human attitudes toward various animals and why we regard them in stereotyped ways.

Dagg, A.I. *Canadian Wildlife and Man.* Toronto: McClelland and Stewart, 1974. Hardcover, 192 pp. $10.00.

This book deals with the way wildlife (nondomesticated birds and mammals) has affected man and vice versa. It traces the history of wildlife in Canada from the Ice Age to the present; discusses the relationship of wildlife to forests, agriculture and urban areas; examines wildlife management, endangered species and importation (bringing in foreign species); looks at ailments common to wildlife and man and considers the effects of pollution and man-made structures on wildlife; and concludes with a section on wildlife and habitat conservation in Canada.

Foster, Janet. *Working for Wildlife: The Beginning of Preservation in Canada.* Toronto: University of Toronto Press, 1978. Hardcover, $19.95.

Froom, Barbara. *The Snakes of Canada.* Ottawa: National Museums of Canada, 1966. Hardcover, 628 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $17.50.

Herald, Earl S. *Fishes of North America.* New York: Doubleday, n.d. Hardcover, 254 pp. $9.95.

Husek, V.P. *Wildlife Land Management for Ontario Landowners.* Ont. Dept. of Lands and Forests, 1970. 21 pp. Free. Available from Ont. Ministry of Natural Resources (Queen's Park, 99 Wellesley St. W., Toronto M7A 1W3).

Explains what a landowner can do for wildlife. Covers various small game (ruffed grouse, cottontail rabbit, etc.) and deals with woodland borders, hedgerows, shrubs and trees as habitat.

Lagacé, Michel. *Groupe de recherche d'impact sur la faune.* Québec Ministère du tourisme, de la chasse et de la pêche, Direction de la recherche faunique (9530, rue de la Faune, Orsainville, Québec G1G 5E6), Nov. 1976, 16 pp.

Describes the role, objectives and programs of this group within the Quebec Ministry of Tourism, Game and Fish. The Ministry has available a series booklets describing the game and sportfish of the province. For other Ministry publications see *Liste de publications et rapports du secteur faune, de son origine à 1975.*

MacCrimmon, Hugh R. *Animals, Man and Change: Alien and Extinct Wildlife of Ontario.* Toronto: McClelland and Stewart, 1977. Hardcover, 160 pp. $10.00.

Maini, J.S. and Carlisle, A. *Conservation in Canada: A Conspectus.* Environment Canada, Canadian Forestry Service (Ottawa K1A 0H3), Publication No. 1340, 1974. 441 pp.

Includes chapters on wildlife and fisheries in Canada.

Mastin, Mary, "Willows Save Streams in N.Y.", *Globe and Mail*, 19 July 1978.

Describes New York's program of stream enhancement involving local anglers, and compares it to the Ontario approach. See Case Study 36 in 3.1 Streams and Valleys.

McGonigle, Michael, "Canada Plays a Dark Role in Supporting Whale-Hunters", *Globe and Mail*, 5 July 1978, p. 7.

Criticizes Canada's participation in the International Whaling Commission and the associated slaughter of whales. He argues, "To those aware of the high intelligence and poetic beauty of these unique creatures, their brutal treatment for small commercial gain is a moral crime of historic proportions". This view is strongly disputed by the government.

McTaggart-Cowan, I., "The Status of Canadian Wildlife", in Canadian Environmental Advisory Council. *Annual Review*, 1976. The Council (Ottawa K1A 0H3), 1976.

Provides valuable lists of species considered rare and endangered in Canada.

Mosquin, Theodore and Suchal, Cecile. *Canada's Threatened Species and Habitats.* Canadian Nature Federation (203-75 Albert St., Ottawa K1P 6G1), 1977. 185 pp. $8.00.

Proceedings of a national conference, the first that focused on Canada's threatened species and habitats. The 39 papers cover: the problem in a national context including issues of legal enforcement; large land mammals; the marine world; birds; amphibians and reptiles; plants, insects, molluscs and freshwater fishes; the protection of natural habitats; and future problems and solutions. See especially D.E. McAllister and C.G. Cruchy, "Status and Habitat of Canadian Fishes in 1976" which includes a list of endangered fish species, and M. Singleton, "Endangered Species Legislation in Canada".

Potvin, F. (éd.). *L'aménagement intégré de la faune et de la forêt du Québec.* Québec Ministère du tourisme, de la chasse et de la pêche (9530 rue de la Faune, Orsainville, Qué. G1G 5E5), Bull. 16, 1972. 48 pp.

This publication ("Integrated wildlife and forestry management in Quebec") defines the characteristics of land and water habitats and forestry development principles for wildlife areas. See also: Gilles Paquet et al., *Nécessité, justifications et rôles des normes d'exploitation forestière en vue de la conservation de la faune* (Ministère du tourisme, de la chasse et de la pêche, Service de l'aménagement de la faune), janvier 1975, ("Need, justifications and use of principles with respect to wildlife conservation").

Québec Ministère du tourisme, de la chasse et de la pêche. *Workshop on Remote Sensing of Wildlife, Québec, 18, 19, 20 November 1975.* Québec Ministère du tourisme, de la chasse et de la pêche, Direction de la recherche faunique (9530, rue de la Faune, Orsainville, Québec G1G 5E5), 1975.

Proceedings of the first workshop in North America on this subject. Remote sensing techniques – aerial photography, radar, thermal sensing, microwave, satellite imagery – are now available to biologists for collection of data on wildlife. Thirteen papers examine the state of the art.

Ruttner, Franz. *Fundamentals of Limnology.* Toronto: University of Toronto Press, 1963. Hardcover, 307 pp. $8.50.

Schwartz, Charles F. et al. *Wildland Planning Glossary.* U.S. Dept. of Agriculture, Forest Service (P.O. Box 245, Berkeley, CA 94701), 1976. Paperback, 252 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 001-001-00413-8, $2.45 + 25 % outside USA.

Scott, William B. and Crossman, E.J. *Freshwater Fishes of Canada.* Fisheries Research Board of Canada (Environment Canada, Ottawa K1A 0H3), Bulletin 184, 1973. 966 pp.

Soil Conservation Society of America. *Plants, Animals and Man.* SCSA (7515 Northeast Ankeny Road, Ankeny, Iowa 50021) 1973. 272 pp. $5.00.

Proceedings of the Society's 1973 Annual Meeting. Includes 7 papers on fish and wildlife resources. See especially E.L. Cheatum, "Fish and Wildlife in Relation to the Societies of Man".

Urban Wildlife

Wildlife in one form or another exists in urban areas including the largest and most densely concentrated. Some urban centres have high populations and a diversity of wildlife. Until recently the presence of urban wildlife was mostly the result of chance rather than of deliberate decisions in the development of human settlements. Whatever wildlife a city has tends to occur through sheer adaptability, because it has not yet incurred some individual's or some organization's displeasure and so no concerted effort has been made to remove it, as the result of some policy taken for another purpose, or because urbanization has not yet reached it. Things are changing, however, as more people gain an awareness of the wildlife in their midst. For example, when the National Wildlife Federation launched its Backyard Habitat program four years ago with an article telling people how to manage vegetation to attract wildlife to their properties, it received requests for a quarter million reprints within half a year.

People in urban areas tend to like songbirds while disliking "pests" such as pigeons and starlings. Most also like squirrels, chipmunks and cottontails (though not necessarily on their properties) while disliking skunks, rats and even racoons. These attitudes toward wildlife are important. A species is more likely to disappear if its needs conflict with man's. Of course, it must be recognized that some types of wildlife are undesirable, possibly even a health hazard, in urban areas. Furthermore, some people dislike many, perhaps all, forms of natural life.

The difference between wildlife and other resources makes it especially important to be realistic about the current status of urban wildlife when the intent is to promote measures to protect it. Although wildlife species indisputably form part of natural systems – certain birds keep down undesirable insect populations, for example, and each species serves its function in the food chain – it is nonetheless difficult to make a convincing argument that wildlife is essential to human existence. It used to be highly valued for food or game. Today its value is moving toward the category of "desired for human satisfaction or as an end in itself". Few of us would like to live in a city with no songbirds, no squirrels, no wildflowers. They enrich our surroundings and, with other natural features, make the urban landscape more livable. Aside from such psychological and aesthetic benefits, wildlife *does* serve certain functions of value to man: as an indicator of environmental quality (if certain animals and plants are poisoned by

pollution, chances are human beings are affected too, whether they realize it or not), as recreational resources (birdwatching, sport fishing, photography, etc.) and in outdoor education. As an area is urbanized many creatures are unable to survive, mainly because their habitat disappears. Other factors adversely affecting wildlife include air and water pollution and the special hazards created by urban areas (tall glass-and-concrete buildings into which birds unwittingly crash, traffic and urban predators, such as cats). A few animals adapt readily to urban areas – raccoons, squirrels, skunks, rats, pigeons. These are mostly nuisance animals, it is worth noting, often not native to the area. The most successful are able to adapt to the new conditions, use man-made structures, cope with man's food and win his favour.

The number and variety of wildlife species found in an urban area depends on the diversity of habitat the area is able to maintain or create. Vegetation and water are critical. In many urban areas these occur together in creek valleys, making them prime habitats for wildlife, or even in floodplains. Parks can also offer significant habitats depending on their use and maintenance (through herbicides or pesticides). The same applies to back yards and streets, especially where continuous corridors of vegetation are allowed to develop – along back fences, for example. Buildings themselves can provide excellent habitat depending on their design. Providing nesting spots for birds can dramatically increase their population.

The urban fringe and the rural countryside often constitute the main habitat for wildlife. Here also are the opportunities to create the conditions under which future wildlife may flourish. More will have to be done in this regard than has been done in the past, however. Cities and towns with urban-fringe habitat not yet destroyed by nonurban activities like agriculture may be implicitly counting on the fringe to continue being home to deer, fox, muskrat, coyote, small mammals, birds and other species. If the urban area's environmental quality in wildlife terms depends on the existence of an adjacent nonurban area where wildlife forced out by urban development can retreat, the question becomes: how long will this continue to be so?

Preserving remnants of the now-undeveloped area, such as woodlots, may be desirable for various reasons but it won't do much for the wildlife; habitat opportunities would be quite limited. Preserving creek valleys and associated woodlands, and managing their resources to assure the necessary level of water quality as well as to protect the species against undue urban disruption, comes closer to being a solution. It will not save some of the species, though (deer and coyotes, for example). And behind that problem is another: deciding on what "level" of management is feasible, that is, what extent of wildlife existence can reasonably be aimed for in



a future, more urbanized world? If the aim is too low or too high, it will be questionable whether the results justified the cost and effort. Some of the wildlife now living in the nonurban fringe will inevitably leave that area when their habitats are surrounded by industries, highrises, cars, parking lots and people. A reasonable objective may be to prolong the existence of such wildlife for as long as possible. But that still leaves open the question of the degree of long-term wildlife management.

Sound information is essential to such planning and management. Few if any urban areas have a careful, ongoing inventory of the wildlife and its habitants within their boundaries (see 5.2 Information). Here planners can draw on local organizations such as field naturalist clubs which routinely conduct natural resource inventories and whose members are committed to protect the wildlife resource (See Case Study 35 in 3.1 Streams and Valleys).

Case Study 28
Dogs Shot for Chasing Deer
Submitted by David Brown, McGill University

One of the potential conflicts arising from the provision of space for wildlife on the urban fringe was dramatically illustrated in a series of instances in the Rigaud sanctuary for deer, about 55 km west of Montreal. As reported in the *Montreal Star* (22 March 1978), two dogs, a collie and a German Shepherd, were shot while chasing deer. This brought the total number of dogs shot that season to seven. The chief game warden said that 25 to 30 deer had been found dead in the sanctuary that winter, most of them killed by dogs. The problem is particularly acute when the snow is just hard enough to support the dogs but not the deer. Trapped in the snow, the deer become exhausted and die of starvation.

Similar conflicts are likely to occur more frequently, as urban residents encourage an increasing variety of wildlife to share their environment, unless domestic animal-owners can be persuaded to take their responsibilities more seriously.

Case Study 29
Wildlife Refuge in Mississauga Threatened, Then Saved

The City of Mississauga proposed building a sewer line along a public right-of-way just 30 feet from the home of Mrs. Bernice Inman. She had been carrying on the 50-year work of internationally known naturalist Roy Ivor and, over the past 17 years on the virgin forest on her property, had developed her own wildlife sanctuary through which 2 000 birds passed each year. The adjoining property was protected by a greenbelt designation.

In 1977 the Credit Valley Conservation Authority granted approval for the sewer line to serve two nearby subdivisions. Between January and March 1978, the Mississauga Environmental Advisory Board recommended to the City planning board that the sewer line not be built, thereby preserving that bit of forest and removing the threat to Mrs. Inman's wildlife refuge. A hydrogeology report showed that the forest's wetland provides a habitat for wildlife and a nesting area for waterfowl besides absorbing runoff and supplying the adjoining creek with water. The planning board agreed and city council concurred with the Board. Council also acted (unanimously) to include the sanctuary with an Environmental Protection Area designation, and in that way to protect the area's environmental integrity.

Abstracted from Donald Grant, "Wildlife refuge, work of 2 lives, faces city threat", *Globe and Mail*, 30 January 1978, and "Mississauga saves wildlife sanctuary, changes route of new sewer line", *Globe and Mail*, 2 March 1978.

Information Resources

See also:
2.6 Wildlife
3.6 Environmentally Sensitive Areas
3.7 The Rural-Urban Fringe
4.2 Urbanization

Dean, P.B., "Wildlife Needs and Concerns in Urban Areas", in Wiken, E.B. and Ironside, G.R. (eds.). *Ecological (Biophysical) Land Classification in Urban Areas. Proceedings of a Workshop, Canada Committee on Ecological (Biophysical) Land Classification, 23 & 24 November 1976, Toronto.* Ottawa: Environment Canada, 1977. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $4.00.

Discusses wildlife needs for food, breeding habitat, shelter and escape habitat. Sets out some management and ecological principles concerning home range and territorial requirements, predator-prey relationships and edge effect (maximizing the length of ecotone transition zone from one vegetation type to another). Closes with some wilflife concerns in urban areas.

Fuhriman, Jerry and Crozier, Edward S. *Planning for Wildlife and Man.* Washington: U.S. Dept. of the Interior, Fish and Wildlife Service, 1975. 56 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Catalog No. 1 49.2:W64/8, $1.10 + 25% outside U.S.A.

A handbook, addressed to wildlife area managers, that (a) provides information usable for organizing land uses and specific functions in wildlife management areas, (b) provides an overview of basic land design principles related to the needs of such areas, (c) offers insights into man's reaction to the visual aspects of the wildlife environment, and (d) illustrates criteria for sample outputs of wildlife management areas (e.g., waterfowl production, wildlife maintenance, hunting and fishing, birdwatching, hiking trails, photography, outdoor education, camping) each analyzed for certain factors (e.g., for photography: accessibility, subject status, site characteristic and season). Optimum, acceptable and minimum conditions are described.

Geis, Alfred D. *Recognition of Wildlife in the Planning Process: Two Case Histories Near Washington, DC.* U.S. Dept. of the Interior, Fish and Wildlife Service, (Laurel, Md 20811), 1975. 13 pp.

Paper presented to the American Institute of Planners 1975 Annual Conference. The case studies are: use of an "environmental quality corridor" by Fairfax County planners (Dept. of Environmental Management, Massey Building, 4100 Chain Bridge Road, Fairfax, VA 22030) to prohibit development on a floodplain and protect upland areas for wildlife; and establishment, by the Fish and Wildlife Service, of a wildlife data collection program on the site of Columbia new town, between Washington and Baltimore.

Keyes, Dale L. *Land Development and the Natural Environment: Estimating Impacts.* The Urban Institute (2100 M St. NW, Washington, DC 20037), 1976. 128 pp. $4.95.

Wildlife is covered in Part 3: value, methods of habitat analysis and population census, estimating entire conditions, and recommendations for the planner.

Lancaster, R.K. *Bird Communities in Relation to the Structure of Urban Habitats.* University of British Columbia, Dept. of Zoology (Vancouver V6T 1W5), 1976.

Unpublished M.Sc. thesis.

Leedy, Daniel L. et al. *Planning for Wildlife in Cities and Suburbs.* American Society of Planning Officials (1313 East Sixtieth 60th St., Chicago, IL 60637), P.A.S. No. 331, 1978. 64 pp. Available only to subscribers of ASPO's Planning Advisory Service (some libraries and planning offices suscribe). $6.00.

A manual that brings together two disciplines – wildlife management and urban planning – to focus on (a) developing an appreciation of wildlife considerations as an integral aspect of urban planning, and (b) incorporating principles of wildlife management in the urban planning process. Chapters 1 and 2 provide information on wildlife found in urban/suburban areas, urban wildlife values, effects of urbanization on the environment and the response of fish and wildlife to habitat changes, and the need for wildlife planning and management. Chapter 3 deals with basic needs of wildlife, the nature of wildlife management in relation to urban planning, and the need for planners and biologists to work together in this regard. Chapters 4-6 provide guidance for incorporating wildlife into site and regional planning for undeveloped areas as well as into existing urban areas. Chapter 7 outlines special wildlife planning and design concerns related to water management, erosion control, open space and vegetation management, erosion control, open space and vegetation management, roads and airports. Chapter 8 summarizes principles and suggested approaches.

McKeating, Gerald B. (ed.). *Nature and Urban Man.* Canadian Nature Federation (203-75 Albert St., Ottawa K1P 6G1), 1975. 134 pp. $4.00.

Proceedings of a 1974 Symposium. The 19 papers cover various aspects of urban wildlife in different parts of Canada, and the planning and management of the wildlife resource. See also: Gerald McKeating, "Wildlife Studies in Urban Areas", in Wiken and Ironside, 1977, cited under Dean, above. Evidence exists to suggest that urban dwellers value natural areas in their community but an education process for residents, developers and planners (among others) is clearly needed. A number of wildlife studies undertaken in cities are described; little application of the acquired information has occurred.

McKeating, Gerald B. and Creighton, William A. *Backyard Habitat.* Ontario Ministry of Natural Resources (Queen's Park, 99 Wellesley St. W, Toronto M7A 1W3), 1975. 9 pp. Free.

Niwinski, Alice, "Wildlife on our Doorstep", *Urban Reader*, Vol. 4, No. 6, 1976. Available from City of Vancouver, Social Planning Dept. (City Hall, 453 West 12th Ave., Vancouver V5Y 1V4). Free.

A useful concise article on wildlife in the city.

Noyes, John H. and Progulske, Donald R. (eds.). *Wildlife in an Urbanizing Environment.* Massachusetts Cooperative Extension Service (Room 213, Stockbridge Hall, University of Massachusetts, Amherst, MA 01002), 1973. Paperback, 182 pp. $3.00.

Proceedings of a symposium, Nov. 1973. Contains 34 papers on philosophy of urban wildlife, public and private roles in urban wildlife management, studies in urban wildlife, and people in urban wildlife.

Ontario Ministry of Natural Resources. *Ontario Fish and Wildlife Review,* Vol. 16, No. 4, Winter 1977. $0.75 per issue or $2.50 per year, remittance to Treasurer of Ontario and sent to Publications Service, Ministry of Government Services (Toronto M7A 1N8).

This issue is devoted exclusively to endangered species in Ontario and to the Province's "Endangered and Threatened Species Program".

Sawyer, Edmund J. *Homes for Wildlife: Baths and Feeding Shelters. How to Make Them and Where to Place Them.* Sixth Edition. Cranbrook Institute of Science (Bloomfield Hills, Mich. 48013), 1974. 36 pp.

Thomas, J.W. and DeGraaf, R.M. *Wildlife Habitats in the City: A Primer for Planners.* 1975. 41 pp. Available from U.S. Dept. of Agriculture (Range and Wildlife Habitat Laboratory, Box 2315, La Grande, Oregon 2315).

Paper presented to the 1975 Annual Conference of the American Institute of Planners. The authors trace the history of wildlife management in rural and urban areas. They examine current concepts and approaches for urban wildlife planning and management. Guidelines are cited, principles are advanced for creating and maintaining habitat in urban areas, and opportunities for action are identified. An extensive bibliography is included.

Urban Wildlife Research Center, Inc. *Planning for Wildlife and Environmental Enhancement in Urban, Suburban and Urbanizing Areas.* U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services (Washington, DC 20402), Feb. 1977. Unpublished draft manuscript.

U.S. Dept. of the Interior, National Park Service. *Man, Nature, City* and *The City as a Biological Community.* U.S. Dept. of the Interior (Washington, DC 20240), 1972 and 1974. Free.

Two booklets in the Department's "Urban Ecosystem" series.

2.7 Interrelationships

Acknowledgements 2.7

This section includes contributions from:

George Atamenenko
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John Walker
Phil Wood
Brian Wilkes
Paul Wilkinson

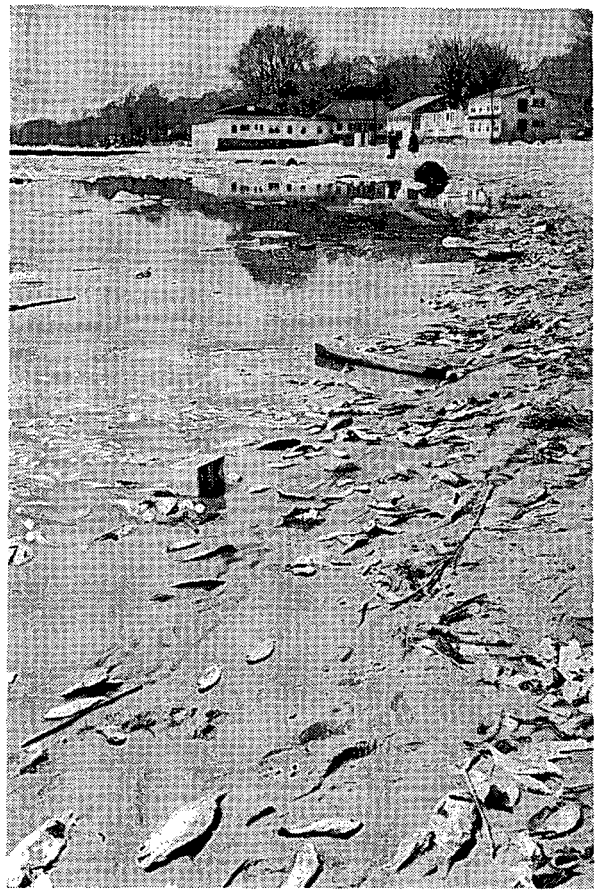
The components of the natural environment described in the foregoing sections do not operate in isolation. They are related both in obvious and subtle ways. This simple fact of life is easy to accept but exceedingly difficult to operationalize. We compartmentalize things in our minds, on paper and in our institutions. Even where the awareness of interrelationships exists – for instance, between education and subsequent employability – it is often not translated into action.

For environmental planners Dorney's four levels of land planning illuminate this problem. The first, "flat earth planning", treats sites as though they were flat featureless plains; the arbitrary imposition of a single gridiron pattern on a wide array of topographic conditions exemplifies this approach across Canada. The second, "contour planning", takes account of the lay of the land but not much else; many newer residential subdivisions illustrate this approach. "Constraints planning" is the third level, where the designer identifies features of the natural and cultural landscape and treats them as limitations on human activity; this approach is increasingly common though hardly universal. Much rarer is the fourth level, "ecosystem planning", which goes a step further by overlaying a systems approach onto the ecological concerns of constraints planning.

The last step, from level three to four, is a difficult one to take (and is probably unnecessary and/or impractical for smaller sites, Dorney argues). The tendency even in environmentally oriented planning, whether for settlements or specific functions, is to take account of certain obvious natural features but overlook the less apparent natural systems and processes. A grove of trees is saved but no attention is paid to the groundwater system upon which survival of the trees depends. As McHarg puts it:

> *The phenomenal world is a process which operates within laws and responds to these laws. Interdependence is characteristic of this process, the seamless web of nature. Man is natural as is the phenomenal world he inhabits, yet with greater power, mobility and fewer genetic restraints; his impact upon this world exceeds that of any creature. The transformations he creates are often deleterious to other biological systems, but in this case he is no different from many other creatures. However, these transformations are often needlessly destructive to other organisms and systems, and even more important, by conscious choice and inadventure, also deleterious to man.*

Where a system is involved, change in one part results in changes to others. Ignoring the systemic effect may lead to counter-productive action and subsequent loss of something valued. Environmental planners, therefore, have to attempt to deal with whole systems and processes – "attempt" for three reasons: the necessary knowledge of such systems/processes and their behaviour is often sadly lacking; they have a "learning" capacity, adapting in unforseen ways, which renders aspects of their behaviour unpredictable; and we rarely are given the time or money to obtain the level of understanding we would prefer.



Information Resources

Dasmann, Raymond F. *Environmental Conservation.* 3rd Edition. New York: Wiley, 1972. Paperback, 473 pp.

Chapter 1, "The Nature of the Environment", provides a concise discussion of the essential interrelatedness of environmental systems, covering ecosystems and communities, food chains, natural processes/cycles, soil formation, biotic succession and limiting factors. Quoting Odum, "The presence and success of an organism or group of organisms depends upon a complex of conditions. Any condition that approaches or exceeds the limits of tolerance is said to be a limiting condition or a limiting factor". Annotated further in 1.1 Environmental Issues.

Dorney, R.S. and Rich, S.G., "Urban Design in the Context of Achieving Environmental Quality Through Ecosystems Analysis", *Contact* (University of Waterloo, Faculty of Environmental Studies) May 1976, pp. 28-48.

McHarg, Ian A., "Open Space from Natural Processes", in Wallace, David A. (ed.). *Metropolitan Open Space and Natural Process.* Philadelphia: University of Pennsylvania Press, 1970. Paperback, 199 pp.

Natural Systems and Processes

A system is a set of interacting and interrelated elements. The structure of a system provides the means by which a process occurs, as the digestive system facilitates the process of digestion,

Various conceptual schemes have been put forward to structure the interacting components of environmental systems. Kaiser's, shown by Figure 2.32, simply divides the environment into two subsystems – physical and biological – and shows how their components relate. Others divide it differently. Dorney, for example, sees air, energy, water, land and biota as three interacting subsystems: cultural/historical, abiotic and biotic.

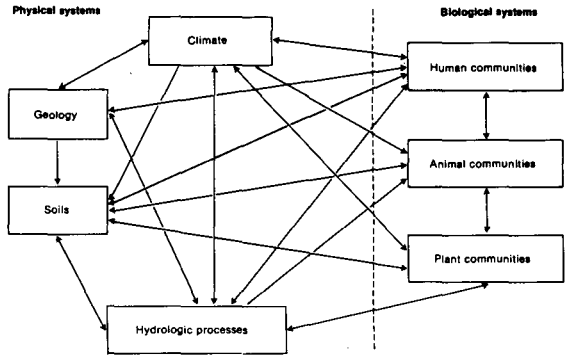


Figure 2.32 Integration of Natural Processes into an Ecosystem

Source: Edward J. Kaiser et al., *Promoting Environmental Quality Through Urban Planning and Controls* (Washington, DC: U.S. Environmental Protection Agency, 1974).

Systems are subsystems of larger systems. Environmental classification can be from the bottom up (as in foregoing sections of this book) or from the top down. While the former may be useful, the latter is essential to reveal certain relationships and, more significantly, the significant systems and processes within which components interact.

At the largest scale the earth can be seen as a single ecological system (ecosystem): a spatially defined community of living (biotic) things interacting with each other and with the nonliving (abiotic) things such as energy, air, water and soil that support them. Man is part of this system. Basic to an ecosystem – which may exist at any scale, since each ecosystem being is open to exchanges with its environment – are flows of energy and nutrients in several familiar cycles.

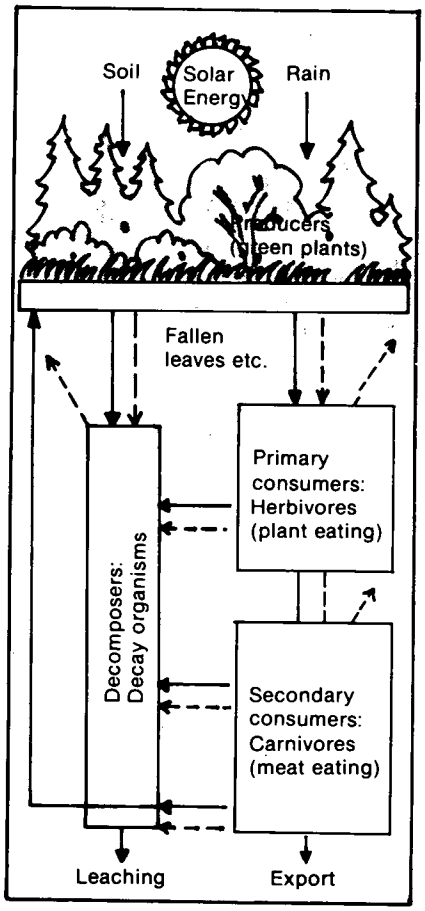


Figure 2.33 The Food Cycle: Flows of Energy (dotted lines) and Nutrients (solid lines).

- In the basic *food cycle*, producer plants by the process of photosynthesis use energy provided by the sun to combine carbon dioxide, water and various minerals into carbohydrates, fats, proteins and vitamins. Herbivores eat plants; carnivores eat herbivores; and dead organisms and other wastes are broken down by reducer organisms (fungi and bacteria) and recycled.
- In the *oxygen and carbon cycles*, the carbon is removed and the oxygen supplied by photosynthesis which captures the sun's energy. Respiration produces the reverse result.

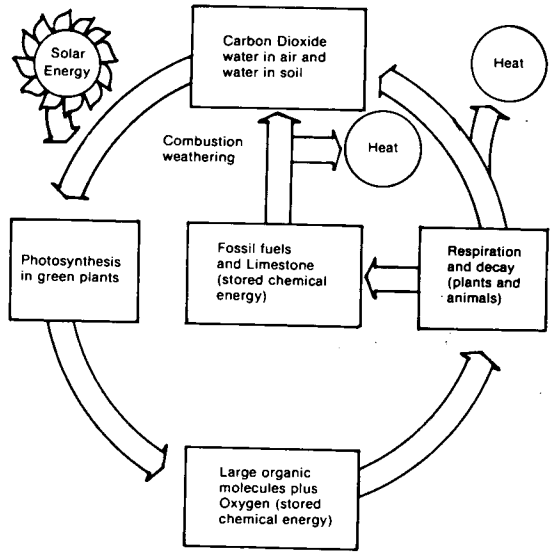


Figure 2.34 The Oxygen/Carbon Cycles
Adapted from: G. Tyler Miller, Jr., *Living in the Environment: Concepts, Problems and Alternatives* (Belmont, CA: Wadsworth Publishing Co., 1975).

- In the *hydrologic cycle* (Figure 2.23 in 2.3 Water Quality) water reaches the earth as rain or snow, filters through the soil or flows over the land as runoff. Some water is returned to the atmosphere by evaporation. The water vapour forms clouds which lead to precipitation, completing the cycle. Through a combination of evaporation and the work of reducer organisms, water is repurified.
- Finally, in the *nitrogen cycle*, this vital gas is converted into forms which plants and animals can use. Much of this takes place in the soil.

Maintenance of these cycles is fundamental to man's survival (though that statement needs considerable qualification). Nature provides energy and certain amenities; at the same time certain inhospitable natural processes, such as hurricanes and floods, constitute intrinsic constraints to human activities. The natural environment is also expected to assimilate human wastes on land, in air and in water. Both the assimilative and the supportive capacities are limited, however. Materials are finite while reducer organisms can decompose only a limited quantity and variety of waste (non-biodegradable plastics, for example). Nature communicates, in the form of pollution, when assimilative capacities are exceeded.

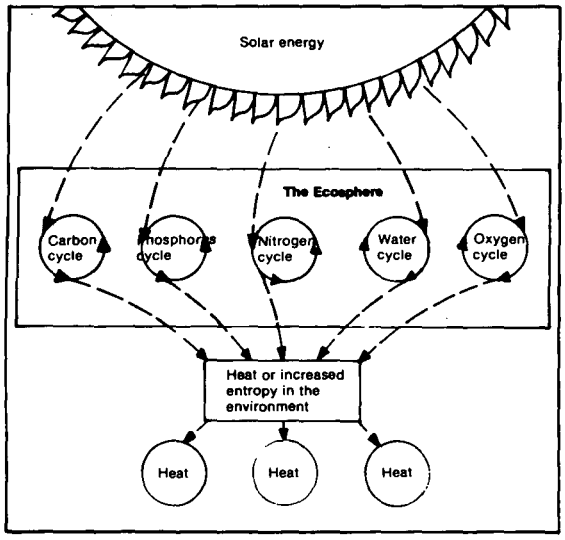


Figure 2.35 Energy Flow and the Ecosphere

Source: G. Tyler Miller, Jr., *Living in the Environment: Concepts, Problems and Alternatives* (Belmont, CA: Wadsworth Publishing Co., 1975). Dotted lines represent energy and solid lines chemicals.

Each of the foregoing cycles can be affected adversely by human activity, with resulting in the loss of part or all of its capacity to work for man. The nitrogen cycle can be upset by nigrogen fertilizers which, while increasing crop yield, can leach with water to create pollutants and unwanted plant growth such as algae. The oxygen and carbon dioxide cycles suffer from use of the air as a free garbage dump, especially by the automobile. The hydrologic cycle is affected when the high proportion of hard surfaces in urban areas (compared with the pre-urban setting) causes an increased amount of runoff to reach receiving streams faster, creating extremes of flood and no-flow. Examples of interference with these basic cycles are part of everyday experience.

The ecosystem concept, though often difficult to operationalize in environmental planning and management, helps us to understand and analyze the natural environment in relation to human activity. Several related concepts are similarly useful:

Interdependence: everything is connected to everything else. Few connections are significant, however. Discovering the key ones and determining their strength is the problem.

Unintended effects: you cannot do just one thing. Interdependence means that changes in one factor are likely to reverberate throughout the system. The widespread long-term effects of DDT, concentrated in food chains, starkly illustrates this concept.

Stability (homostasis): ecosystems have an historical quality. They are self-regulating as they evolve toward a state of equilibrium. More stable systems tend to be more complex. Complexity in turn is associated with diversity. A large number of species and/or interactions usually (though not always) increases adaptiveness to stress while negative-feedback controls maintain populations at levels necessary for constant functioning.

Resilience: the ability of a system to bounce back, to absorb continuous stress and still persist, within certain *limits* or thresholds. Where ecosystem stress is man-induced, resilience may be more significant than stability/diversity in understanding and predicting the functioning of the system.

Development. Evolution, often in stages and through differentiation/integration, leads to a more advanced and complex stage where new properties and potentials emerge; think of a child developing into an adult. Odum argues that ecosystems develop, just as individual organisms do, because the biotic components are capable of modifying and controlling the physical environment to varying degrees. "Young" ecosystems, such a forest in early stages of succession, are characterized by an emphasis on productivity, low diversity of species (though many individuals), high birth rates and rapid growth rates, linear food chains, little recycling, and a low resistance to disruption. "Adult" systems, by contrast, balance growth with maintenance, are diverse, have web-like food chains, recycle, are stable while remaining dynamic, and can withstand considerable disturbance. Man's optimum in terms of development is to maximize production of single crops on a site (agriculture, forestry, etc.); nature's optimum, on the other hand, is a complex living system that de-emphasizes production. If the self-maintaining capacity of the biosphere is to be maintained, ways must be continually found to achieve balance at various levels (biosphere down to specific site or organism) and in ways appropriate to different cultural settings, between natural systems and man's productive use of the environment.

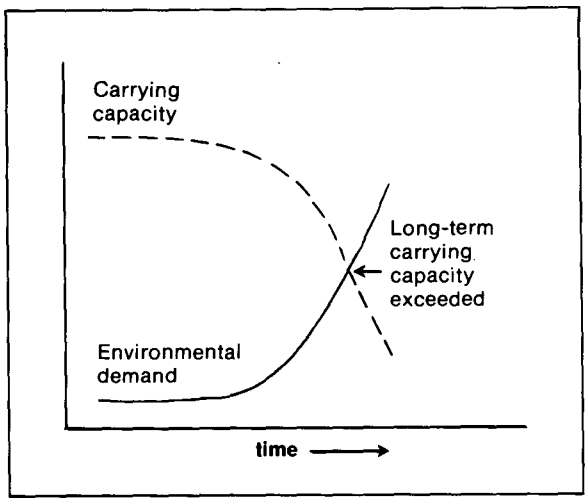


Figure 2.36 Carrying Capacity

Carrying capacity. Closely related to resilience is the concept of carrying capacity. Originally drawn from ecology, it meant the maximum number of a species that could be supported indefinitely by a particular habitat without degrading the environment or diminishing future carrying capacity. Applied to human activities, carrying capacity relates human and economic interventions to resulting changes in the resource base and environment of a given area. As with resilience, the emphasis is on identifying various limits beyond which change cannot be absorbed without irreversibly damaging, degrading or transforming the environmental system or resource. The potential value of carrying capacity in environmental planning is twofold: first, as a concept for use in guiding the planner's work and for explaining it to others (the idea that a lake can stand only so much sewage is easy to grasp); and second, as a means of assessing the impacts of proposed developments on a given environment's capacity and quality. Translating the concept into workable planning methods is still in the early stages but it is promising (see an example in 3.3 Lakes), and in the report by Clark (annotated in 2.7 Energy).

Urban ecosystem. Some argue there is no such thing since in a city a single organism (man) dominates, and development is determined not by energy and nutrient flows but by politics and economics. Nonetheless, the urban ecosystem has been advanced as a framework useful for both analysis (e.g. input-output) and analogy. Stearn sees "city as ecosystem" consisting of man-made energy and material flows, the natural environment, and the socioeconomic-political system controlling the urban area.

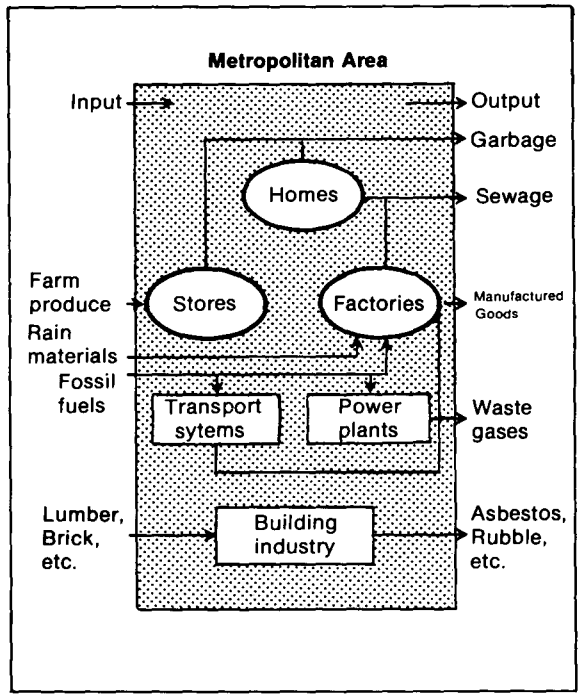


Figure 2.37 Urban Ecosystem Model

Adapted from: Alden D. Hinckley, Applied Ecology: A Nontechnical Approach (New York: Macmillan, 1976). Note that the model simplifies the flow of energy and materials by omitting water, electricity and merchandise distribution.

Applying ecosystem thinking to urban areas in an analogous way highlights their dependence on input from their rural hinterlands and the impact of their wastes on nearby natural systems. Such an approach also demonstrates the need to understand the city as a natural system, to identify areas hazardous to human life and property, and to discover which areas are intrinsically suited to various forms of urban activity.

Information Resources

See also:
1.2 Characteristics of Environmental Problems
1.3 Characteristics of Environmental Planning
2.7 Natural Environments and Human Activities

Bishop, A.B. et al. *Carrying Capacity in Regional Environmental Management.* Washington, DC: U.S. Environmental Protection Agency, EPA-600/5-74-021, 1974. Paperback, 170 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $2.55 + 25% outside U.S.A.

Examines the concept of carrying capacity for application in a regional setting. Traces the evolution of carrying capacity from ecological systems, then adapts it to human activities, along four dimensions: resource/production, environment/residuals, infrastructure/congestion and production/societal relations. Carrying capacity is then viewed from the standpoint of resources, regional structure and regional models to see how it fits within the theoretical and analytical considerations related to these areas. A carrying-capacity based planning process is described; the forces for change in the region are analyzed in terms of the impacts on identified carrying capacity indices and compared with desired levels to pinpoint areas in which capacities have been exceeded. Use of carrying capacity concepts in urban and regional planning is discussed.

Cairns, J. Jr. (ed). *Recovery and Restoration of Damaged Ecosystems.* Charlottesville, VA: University Press of Virginia, 1977. 531 pp. $20.00.

This book recounts the many different aspects of ecosystem restoration, discussed at a symposium in March 1975. It provides evidence of the need to develop all possible means, from the scientific to the technological, to restore damaged ecosystems.

Cooper, William E, and Vlasen, Raymond D., "Ecological Concepts and Applications to Planning", in McAllister, Donald M. (ed.). *Environment: A New Focus for Land-Use Planning.* Washington, DC: National Science Foundation, 1973. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Catalogue No. NSI.2: EN8, $3.75 + 25% outside U.S.A.

Sets out as principles a dozen ecological relationships that ought to be part of the land use planning perspective (e.g., the ability of the ecological sector to assimilate human waste in an acceptable fashion depends upon their nature and concentration and the biological characteristics of the environment). Each is elaborated in terms relevant to its incorporation into the planning process. Institutions that serve as bases for application are classified and discussed. Similar sources include Eugene Mattyasovszky, "Key Principles in Planning for Environmental Quality", *Plan Canada*, Vol. 15, No. 1, 1975, pp. 38-43; Lynton K. Caldwell, "The Ecosystem as a Criterion for Public Land Policy", *Natural Resources Journal*, Vol. 10, No. 2, April 1970, pp. 203-221; C.S. Holling and M.A. Goldberg, "Ecology and Planning", *Journal of the American Institute of Planners*, Vol. XXXV11, No. 4, July 1971, pp. 221-230; and Eugene P. Odum, "The Strategy of Ecosystem Development", *Science* 164, 18 April, 1969, pp. 262-270.

Dansereau, Pierre. *Harmony and Disorder in the Canadian Environment.* Candian Environmental Advisory Council (Ottawa K1A 0H3), 1975.

Dorney, R.S. *Philisophical and Technical Principles for Identifying Environmental Planning and Management Strategies.* Ecoplans Ltd. (544 Conestoga Road West, Waterloo, Ontario N2L 4E2), 1978. 21 pp.

Annotated in 1.3 "Characteristics of Environmental Planning", where the 41 principles are summarized.

Dunn, Edgar S. *Economic and Social Development: A Process of Social Learning.* Baltimore: Johns Hopkins Press, 1971. Hardcover, 327 pp. $11.50.

A ground-breaking, provocative book that explores the process of learning (defined as the behavioural reprogramming of an organism which allows it to adapt accordingly) through biological and social evolution. Social learning possesses many of the characteristics of biological learning – both kinds of learning lead to unpredictable adaptive responses, for example – but differs in its capacity to generate individual and group behaviour that can itself change behaviour (further adding to the uncertainty created). An understanding of the process of social learning and its deliberate use as "evolutionary experimentation" in planning and managing social systems is proposed and examined in depth.

Ecological Research Ltd. *Parameters for Ecosystem Evaluation.* Environment Canada, Policy Research and Coordination Section (Ottawa K1A 0H3), 1972.

Godschalk, David R. and Parker, Francis H., "Carrying Capacity: A Key to Enviromental Planning?" *Journal of Soil and Water Conservation*, July-August, 1975, pp. 160-65.

Brief but significant article explaining the concept of *environmental* carrying capacity (the limit at which human activity leads to undesirable changes in the environment), extended to *perceptual* carrying capacity (the amount of activity or degree of damage that can occur before we recognize that the environment has changed) and *institutional* carrying capacity (the ability of organizations to guide development toward public goals). Applications and shortcomings of these concepts are discussed.

Hill, Alan R., "Ecosystem Stability in Relation to Stress Caused by Human Activities", *Canadian Geographer*, X1X, 3, 1975, pp. 206-220.

Hinckley, Alden D. *Applied Ecology: A Nontechnical Approach.* New York: Macmillan, 1976. Paperback, 342 pp. $7.75.

Straightforward introduction to ecology.

House, Peter W. *The Quest for Completeness: Comprehensive Analysis in Environmental Management and Planning.* Toronto: Lexington Books, D.C. Heath, 1976. Hardcover, 245 pp. $15.00.

Pages 7-19 present two examples of regional planning applications of the carrying capacity concept: Metropolitan Washington's "optimum growth" and "balanced communities" approach using three kinds of constraints or "budgets" (natural resources which includes carrying capacity, physical, and community-response – see 5.3 Monitoring); and the Pacific Northwest River Basin Commission which undertook a study to determine how a high-quality environment could be maintained in light of population and economic growth (a carrying or sustained-yield approach was used to assess the area's capability to indefinitely sustain various levels of population, economic activities, and degrees of protection of natural and intangible values). Annotated further in 1.3 "Characteristics of Environmental Planning".

Jaakson, Reiner et al., "Carrying Capacity and Lake Recreation Planning", *Town Planning Review*, Vol 47, No. 4, Oct. 1976, pp. 359-373.

Annotated in 3.3 Lakes and described as Case Study 41

Ike, A.F. and Richardson, J.I. *Carrying Capacity for Cumberland Island National Seashore.* University of Georgia, Institute of Community and Area Development (Athens, Georgia 30602), 1974. 35 pp. $1.00.

Recreational carrying capacity is defined as the maximum number of people involved in a given activity that can be supported by a given site without degrading the environment or the quality of the visitor's experience. Management objectives (defining the character of the recreational experiences desired and suggesting optimum values for rates of visitation), ecological constraints (the ability of the natural environment to resist the physical impact of visitors) and quality experience (an experience that is regionally unique, educational and emotionally and spiritually satisfying for the visitor) must all be defined before carrying capacity can be meaningful. The report works through each of these factors for Cumberland Island, a national park on the U.S. east coast.

Kaiser, Edward J. et al. *Promoting Environmental Quality Through Urban Planning and Controls.* Washington, DC: U.S. Environmental Protection Agency, 1974. Paperback, 441 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $4.25 + 25 % outside U.S.A.

Annotated in 1.3 "Characteristics of Environmental Planning".

Nerikar, V.N. et al., "Gauging Florida's Carrying Capacitites by Root Count, Water Seep, Humus Depth, Leaf Litter, Soil Density, Plant Diversity", Landscape Architecture, March 1976, pp. 133-137.

"Carrying capacity", used here in relation to recreation, is defined as the character of use that can be supported over a specified time by an area developed at a certain level without causing excessive damage to either the physical environment or the experience.

Odum, Eugene P., "Air-Land-Water – An Ecological Whole", *Journal of Soil and Water Conservation*, Vol. 24, No. 1, Jan.-Feb., 1969, p. 407.

"Successfully manipulating the environment for the long-term benefit of man depends on the degree to which the whole environment is considered in formulating the strategy. In other words, most of our failures can be traced to short-sighted action that considered only the benefits to a part of the landscape rather than to the whole, or to a lack of understanding of the entire chain of events that must follow any large-scale manipulation of the landscape". Odum goes on to discuss a strategy of ecosystem develoment ("ecosystems undergo orderly development as do individual organisms because the biotic components are capable of modifying and controlling the physical environment to varying degrees") and a corresponding model for landscape planning. See his earlier article, "The Strategy of Ecosystem Development", Science 164, pp. 262-270.

Scientific American. *The Biosphere.* San Francisco: W.H. Freeman and Co., 1970. Paperback, 134 pp. $3.60.

A well-presented collection of basic articles from *Scientific American* on the nature of the biosphere, various cycles (energy, water, carbon, oxygen, nitrogen, mineral) and production processes (food, energy, materials). Sinclair, G.A. et al. *A Method of Calculating Carrying Capacity, Potential Attractiveness and Management Input of a Site for Varied Uses.* Ontario Ministry of Natural Resources (Queen's Park, 99 Wellesley St. W., Toronto M7A 1W3), Research Report No. 94, 1973.

Stearns, Forrest W. and Montag, Tom. *The Urban Ecosystem: A Holistic Approach.* Stroudsburg, PA: Dowden, Hutchinson & Ross, 1974. Hardcover, 217 pp. $18.00.

A project of the Institute of Ecology. Reports on an April 1973 workshop, in four sections: goals for the urban ecosystem; population, physical structure and resource flows; interventions, indicators and models; and case studies.

Wilkes, Brian D. *Carrying Capacity: Reconciling Perpetuation and Use in Natural Environments.* York University, Faculty of Environmental Studies (4700 Keele St., Downsview, Ont. M3J 2R2), 1974.

Unpublished major paper (contact the Faculty's Resources Centre).

Natural Environments and Human Activities

"The natural and civilized worlds must live together or perish separately", Thoreau said. For a long time now, natural environments in much of Canada have existed in increasingly complicated relationships with human activities so that it becomes ever more difficult to tell what is "natural". Native peoples and early settlers experienced a man-environment relationship quite different from that of today. Moreover, they often received direct, unpleasant feedback (such as severe erosion) when they exceeded local "carrying capacity" limits.

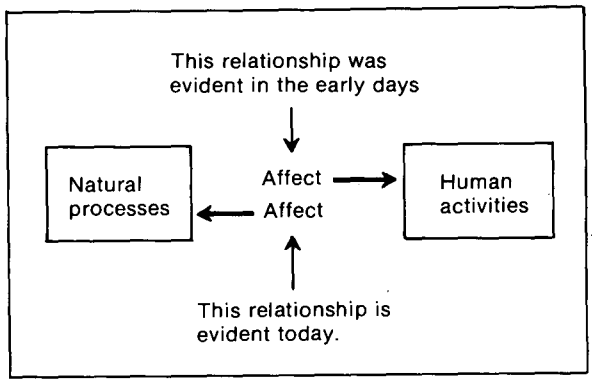


Figure 2.38 Human Activity and Natural Environmental

Source: Reg Lang and Audrey Armour, *Oakville Environmental Report: A Case Study in Environmental Planning* (Toronto: Lang Armour Associates, 1977). Reproduced with permission.

Interaction between human activity and the natural environment has two sides.

1. *Human activities affect natural features, processes and systems.* That is evident from Canada's past, particularly in two periods. The first began early in the country's history with deliberate exploitation of land and natural resources in the name of economic growth and "building the nation". Sometimes the environmental consequences (deforestation, soil depletion, erosion, species loss) were severe. The second period, overlapping the first, followed World War 11. The mid-1940s seems to have been the turning point, after which Canadians began consuming *proportionately* many more resources. After the War population grew rapidly, especially in the large metropolitan areas. The highly concentrated environmental consequences of urbanization, have been significant. And these are not only the direct effects but also the spread of cities over adjoining rural areas, exploitation of the rural hinterland, and cultivation of an urban-oriented man-dominating mentality not easily able to grasp its dependency on natural systems (Jaakson, 1976).

In the current period, production and consumption of certain basic goods have kept pace with population. But a large group of goods has been produced at rates far in excess of population growth. Some of these, such as electronic equipment, have characterized "the new affluence". Most of the rapid increase, however, has resulted from the *substitution* of one good for another, usually for the sake of convience and lower apparent cost: synthetics for natural fibres, plastics for wood, detergents for soap, aluminum for steel, truck freight for rail, smaller fertilized acreage for larger non-fertilized farm operations, non-returnable for returnable bottles. As a result of these displacements, certain related activities have also increased rapidly – production of chemicals used in making synthetics and plastics, for example.

These trends were possible because energy was cheap and perceived as inexhaustible; conversely, each substitution involved an increase of several times the present energy use. For instance, production of synthetics, plastics and aluminum uses much more energy than before. Agriculture offers another dramatic example. While farm production has more or less paralleled population growth the number of farmers has dropped drastically. Cheap energy, in the form of fertilizers and farm machinery, has displaced labour and land. The energy required to produce, process and prepare food for consumption is now several times that in the food itself. Overall per capita energy consumption, which held steady up to World War II, has doubled over the past 30 years (although the increase has slowed recently).

The energy-intensive changes in technology and production since World War II have another disturbing characteristic: compared with what they replaced *their environmental effects are much greater.* Fertilizers and pesticides, detergents, new and strange combinations of chemical pollutants accompanying synthetics and plastics – all of these have been revealed as "costs of progress". Increased pollution and waste are generated by the lifestyle of a society that uses its technology for greater convenience and profit without full regard to the consequences.

High energy consumption and massive environmental impact are especially evident in a small group of industries – pulp and paper, iron and steel, smelting and refining, cement and concrete manufacture, lime manufacture, petroleum refining and industrial chemicals – which are central to Canada's resource-exploitation economy. In 1973 these industries accounted for less than 3% of the establishments and employed only 12% of the production workers, yet they consumed 61% of the fossil fuels, 60% of the electricity and 76% of the water intake of all manufacturing (Statistics Canada, 1978). Pollution appears to be inherent in the way our system works. It may be not merely a cost of progress but one of its necessary conditions.



2. *Natural environments constrain human activities.* Such constraints – or, putting it another way, demands for "fit" between human activities and the natural environment – are of two kinds, leading to a third.

First, some constraints are inherent in the natural environment. Flooding, for example is a natural process; since lands subject to flood can be hazardous to life and property, a high probability of flooding of a piece of land constitutes a constraint on its use. Sometimes such constraints can be overcome, perhaps in this case

by building flood control structures. Care is needed, though, to ensure that the cure is not worse than the disease (and the option of not building there at all should not be overlooked). Many examples exist where a perceived constraint (e.g., a forest occupying what was thought to be prime land on which to grow crops) was followed by narrow-sighted action to overcome the constraint (massive clearing) which produced adverse environmental effects (more and faster runoff that eroded topsoil and washed it into the streams) leading to a new constraint (silted-up harbour) requiring another corrective action (dredging) which had additional side-effects (alteration of shoreline) and so on.

The second kind of constraint is the result of careless human activity that ignores the first kind. Use of certain land is inhibited, for example, because soil nutrients have been depleted as a result of poor farming practices (a problem now evident in Saskatchewan; see Case Study 7 in 2.1 Land Use and Misuse). This sort of constraint, unlike the first, is not inherent in nature.

Nor is the third kind, which is only indirectly a natural environment constraint: deliberate impositions by individuals and collectivities, upon themselves, as expressions of what they value or what they fear and respect in nature. Deciding to preserve a wildlife habitat because it is felt to be worth saving for present and future generations falls into this category, as does the adoption of regulations to protect an aquifer recharge area from land uses that might create pollution and endanger human health. The former example involves saving something as an end in itself while the latter is more the result of self-interest. Both are the outcome of deliberate decisions to constrain human activity for an environmental purpose.

Constraints to urban development and to human activities in the urban environment are often seen as obstacles to be overcome by the exercise of technology, and some of them no doubt are. They can also be seen, however, as signals of limits to be observed, conditions to be avoided or circumstances to be treated with special consideration. Through careful environmental planning and management, these constraints may be incorporated in the process of urban change so that natural environments may continue to function and deliver their benefits.

Man, it has been observed, is the only species not habitat specific (Berger and Luckman). That does not mean that man is no longer dependent on nature. Rather, his interaction with the rest of the biosphere have come to differ radically from those of other species. Toffler expresses it this way:

> *By changing our relationship to the resources that surround us, by violently expanding the scope of change, and, most crucially, by accelerating its pace, we have broken irretrievably with the past . . . we have set the stage for a completely new society and we are racing towards it . . . and it is this that calls into question man's capacity for adaptation – how will he fare in this new society. Can he adapt to its limitations?*

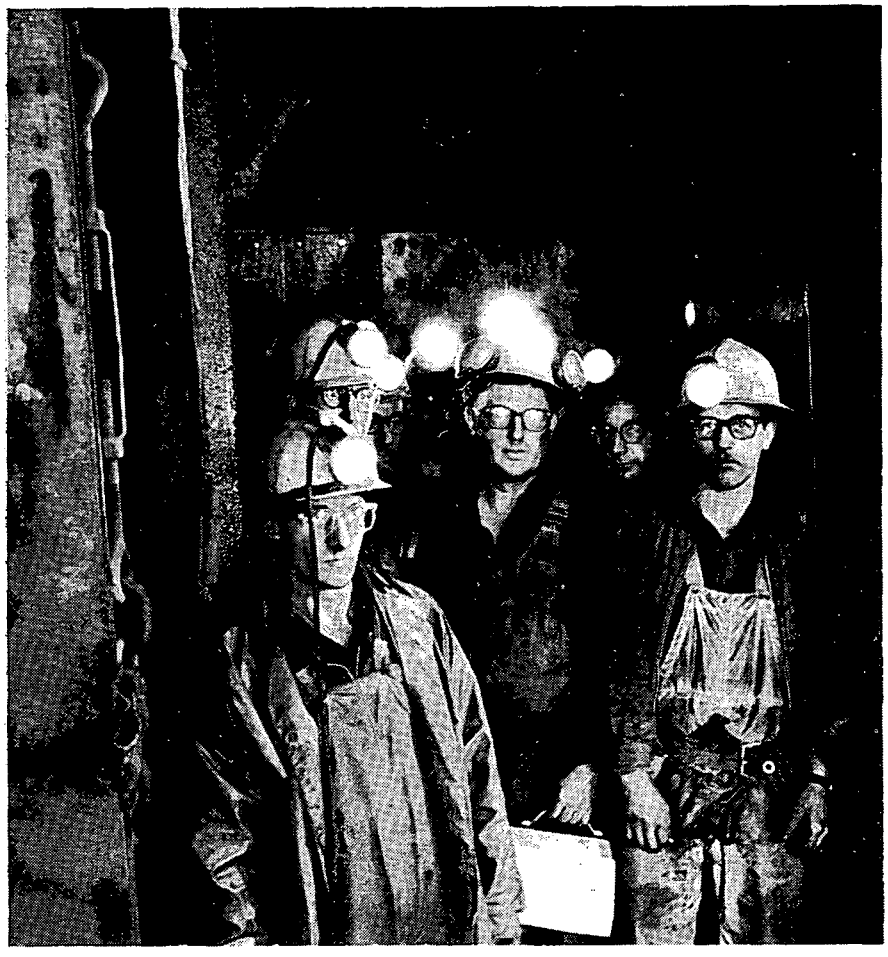
This fundamentally different man-environment relationship has been a long time in the making, perhaps since the Industrial Revolution. But only after World War II did its consequences become particularly noticeable. A *combination* of population growth and the use of technology is responsible. Vallentyne has coined the word "demophoric" to describe the combined interaction of the biological (internal) *and* technological (external) components that now comprise human metabolism. This new interaction: (a) is deeply ingrained in a lifestyle that many people in North America consider "normal" and have come to expect as a right, and (b) has *momentum* which is accelerating dangerously from an environmental, energy and human survival perspective.

Some would argue that the development stage most Canadians have experienced since the War is coming to an end, not only as fossil fuels run out but, more significantly, as basic economic adjustments occur within the nation and among nations. If this is so the significance for the environmental planner is considerable. Past development stage-changes have been accompanied by new man-environment relationships and values. What form the transition will take and the new stage will be like are uncertain at this point, however. Some foresee a "conserver society", much like today's except with the emphasis placed on conservation of energy and resources (not unfamiliar to people who remember the 20s, 30s and 40s). Others go farther to predict a decentralized, small-is-beautiful, alternate-technology response. Whatever its precise form, such a society seems likely to require that we do more with less: reduce consumption of energy,

curb other inefficient consumer habits, encourage greater use of renewable resources, introduce "full-cost pricing" that reflects the costs now hidden or ignored as "externalities", coordinate public and private sector reduction of waste, introduce recycling of the waste that remains, make energy an explicit consideration in determining all government policies, give greater emphasis to equity considerations in the transition, provide public information and education so that people may be better equipped to respond to the need for new ways of doing things, and be prepared for the higher initial costs that inevitably precede long-term savings.

The transition over the next 10 to 15 years, however, could result in painful adjustments being made before society evolves, with the costs borne first and most by those who can tolerate them least. As Eversley (1975) points out, some parts of the world (he is referring to Britain), after a considerable period of economic decline, should by now be seeing positive benefits. But they are not. The problem is that individual and collective decisions are still being taken based on the old set of values rather than on new conserving ones.

> *There should be fewer polluted rivers (and not just cuts in expenditure for cleaning them up). More old buildings should be kept in beneficial use (instead of standing derelict). There ought to be fewer cars on the road (instead of more old cars). The railways should be carrying an increased share of total traffic (instead of finding operations. . . . uneconomic). Road congestion should be getting better (instead of worse, especially in areas which have perforce come back into fashion for holiday and recreation purposes). There should be more housing available for those who need it most since population growth has stopped (instead of homelessness increasing). Dearer fuel should lead to the more rapid adoption of insulation and other heat and energy saving devices, instead of increased advocacy of cheaper building methods (because total resources are scarce) . . . Above all, there is no sign at all that lower growth rates have led to any change in people's ambitions and hopes for their future, and their aspirations for their children. Given this obstinate insistence on seeing their own lives in terms of more space, more mobility, shorter working hours, more labour saving devices, more consumption of consumer durables and leisure service, more and better food, the increasing failure to attain these objectives can only cause greater bitterness.*



This raises a final, particularily troublesome question for the environmental planner who, concerned with environmental *quality*, will find it increasingly difficult to avoid dealing with environmental *equality*. Ironically, in times of rapid growth and prosperity, when a society is best equipped to reduce inequality it faces less pressure to do so than when times are hard and the available means are fewer. Amidst accelerating expectations, the image of an ever-larger pie promises bigger slices for all; relative differences in size of slice seem more tolerable. Futhermore, environmental costs such as pollution, which tend to fall disproportionately on the less well-to-do, seem for the majority to be a temporary

condition to be endured until they too possess the means to consume their economic benefits in one place and their environmental quality in another. But in such times when the promised benefits seem much dimmer and the costs of the transition inevitably fall heaviest on the people least able to afford them, the level of tolerance will decrease. Demands for "equality today, not tomorrow" will increase. Eversley, again in a British context, observes:

> *Middle class theorists profess to be surprised when the unions will not see that the demand for higher money wages will not buy them better living standards when inflation is rampant and productivity falling; but it could scarcely be otherwise as long as some sections of the better-off population still protect themselves very well against any erosion of their living standards, and the ruling classes seen just as much wedded to the idea of a better life through material satisfactions as they always were. At a time when foreign travel is again the privilege of the few, when big houses become cheaper and little houses become dearer, when rich people may change to a slightly smaller car but poor people still have to do without, an environmental revolution of the kind advocated by the conservation movement seems unlikely.*

"The environmental problem", obviously, contains deeply troubling issues that are neither exclusively natural nor human environment oriented. The demophoric characteristic will require a man-in-a-system perspective, replacing the man-outside nature concept that now implicitly prevails (see Case Study 1 in 1.1 Environmental Issues). To do less will be merely to shift environmental problems around, not to get at their ultimate causes. But, as Vallentyne argues, there is also a need to improve our understanding of man-dominated ecosystems *from within*, to grasp the motivations that underlie environmentally destructive human behaviours. With this comes a parallel need to focus explicity on the pros and cons, on who is affected by the reduced acceleration of growth trends, on the human and political consequences of the transition.

Case Study 30
Energy and Environment: The Costs of Convenience

Statistics show that Canadian manufacturers and consumers, especially in the last 20 years or so, have increasingly adopted high-energy enviromentally stressful technologies and practices. Some examples are:

- From 1962 to 1973, the total costs of packaging in the manufacturing industry increased by 128% from $687 million to $1 563 million. Population during that period grew about 19%.
- The average household in 1967 used 76 pounds of paper bags and it still used the same amount six years later. In 1967 each household consumed 13 pounds of plastic bags (earlier than that, plastic bags were rarely used). By 1973 that figure had risen 131% to 30 pounds.
- In 1953 the Canadian household used 49.9 pounds of soap and 31.3 pounds of detergent. By 1974, it was using only 17.6 pounds of soap but 79.8 pounds of detergent.
- Compare the per-household ownership of three high-energy, high-environmental impact appliances:

Appliance one	% of households owning	
	1962	1975
clothes dryer	17.3	48.1
window air-conditioner	1.7	9.2
dishwasher	1.7	15.2

These trends are reflected in the increase in total energy consumed *per person* in Canada: from 161 million BTUs in 1958 to 262 in 1973, an increase of 63% in a period when population grew only a third as fast. Increased energy use, in turn, is explained at least in part by the fact that up to 1973 and the "energy crisis", energy had been costing less each year relative to average income. In 1939 the ratio of average price of purchased electricity to average hourly earnings or production workers in manufacturing industry was 7.0 man-hours per kilowatt-hour; by 1973, that figure was down to 2.0. Those days may have ended but increased energy cost do not yet appear to have bitten sufficiently deep to change basic consumption patterns.

Source: Statistics Canada, *Human Activity and the Environment*, 1978. See Information Resources.

Information Resources

See also:
1.2 Characteristics of Environmental Problems
2.7 Natural Systems and Processes
2.7 Energy
4.2 Urbanization

Adler, Cy A. *Ecological Fantasies: Death From Falling Watermelons.* New York: Delta Book, 1973. Paperback, 350 pp. $3.25.

This book challenges, as "ecological fantasies", predicted environmental disaster. The author does not deny the existence of pollution or the headlong consumption of the world's non-renewable resources. Rather, his concern is that hasty actions forced by environmentalists incite fear and are often counter-productive (e.g., unleaded gasoline with chemicals is more harmful than the lead it replaced) or based on insufficient evidence (he cites one environmentalist as stating, "Although proof of the cause and effect of pollutants and disease is not established, the evidence is overwhelming"). The "myths" he examines in his "search for reality" include: city air is killing us; oxygen is vanishing; Lake Erie is dying; the ocean is rapidly becoming irreparably contaminated by oil spills; the Alaskan pipeline will do irreparable damage to a natural wonderland; and nuclear energy is dangerous to your health.

Berger, Peter L. and Luckman, Thomas. *The Social Construction of Reality: A Treatise in the Sociology of Knowledge.* New York: Anchor Books, 1967. Paperback, 219 pp. $3.25.

Commoner, Barry. "The Environmental Cost of Economic Growth", in Redker, Ronald G. (ed.). *Population, Resources and the Environment.* U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), 1972. Commoner, Barry. *The Closing Circle.* New York: Bantam, 1972.

Commoner states:

> *Basic life necessities, representing perhaps one-third of the total GNP, have grown in annual production at about the pace of population growth so that no significant overall change in per capita production has taken place in this period since 1946. However, within these general categories of goods – food fiber and clothing, freight haulage, and household necessities – there has been a pronounced displacement of natural products by synthetic ones, of power-conservative products, of reusable containers by "disposable" ones.*

Ehrlich, Paul R. and Ehrlich, Anne. *Population Resources, Environment: Issues in Human Ecology.* Second Edition. San Francisco: W.H. Freeman and Co., 1972. Hardcover, 509 pp. $14.00.

Annotated in 1.2 Characteristics of Environmental Problems.

Eversley, David. *Planning Without Growth.* Fabian Society (11 Dartmouth St., London SW1H 9B4, England), 1975. 28 pp.

Holdgate, M.W. and Woodman, M.J. (eds.). *The Breakdown and Restoration of Ecosystems.* New York: Plenum, 1978, 508 pp. $36.00.

Papers examine the extent of man's destruction of ecosystems in northern temperate zones and the resulting losses in environmental stability, biological productivity, genetic diversity and human welfare. Case studies identify and illustrate basic ecological principles for safeguarding ecosystems and rehabilitating those that have been damaged. Guidelines for management of ecosystems are considered, particularly ways of avoiding future devastation while ensuring optimal use of natural resources.

Jaakson, Reiner, "Urbanization and Natural Environments", *Urban Ecology*, 2 (1976), pp. 245-257.

Annotated in 4.2 Urbanization.

Land, George T. Lock. *Grow or Die: The Unifying Principle of Transformation.* New York: Delta Books, 1973. Paperback, 265 pp. $2.95.

This provocative book was reviewed in the *Futurist*, Feb. 1975.

Lang, Reg and Armour, Audrey. Oakville Environmental Report. A Case Study in Environmental Planning. Lang Armour Associates (22 Acacia Road, Toronto M4S 2K4), 1977. Paperback, 181 pp. $10.00.

Chapter 3, "The Past and Future Environment", examines the town's history from an environmental perspective. It concludes that Oakville's development did not occur as a smooth sequence but as a series of stages, each representing a plateau where new conditions arose and a new set of man-environmental relationships emerged. Four such stages were identified: 1. *Survival* (Indian and European settlement) characterized by a strong dependency on the natural environment which provided for most of peoples's needs; 2. *Resource Exploitation* (1820-1860) which saw rapid population and economic growth, lumbering, agriculture, harnessing of water power and creation of a port, and which was accompanied by severe environmental degradation that contributed to collapse of this stage; 3. *Landscape Recovery* (1860-1940s) during which the area's depleted soils and polluted streams as well as its economy returned to a slower more harmonious state; and 4. *Rapid Urbanization* (since the 1940s) marked by industrial development, sudden population growth and prosperity but accompanied by proportionately higher resource and energy use and unprecedented environmental stress evidenced as waste and pollution. A fifth development stage with "conserver society" characteristics seems just around the corner.

Matthews, William H. et al. *Man's Impact on Terrestrial and Oceanic Ecosystems.* Cambridge, MA: MIT Press, 1971. Hardcover, $25.00.

O'Toole, J. and U.S.C. Center for Futures Research. *Energy and Social Change.* Cambridge, MA: MIT Press, 1976. Hardcover, 185 pp. $9.95.

Science Council of Canada. *Canada as a Conserver Society: Resource Uncertainities and the Need for New Technologies.* Ottawa: Supply and Services Canada (Printing and Publishing, Ottawa, K1A 0S9), 1977. Paperback, 108 pp. $2.25.

Annotated briefly in 1.3 Characteristics of Environmental Planning.

Statistics Canada, Office of the Senior Advisor on Integration. *Human Activity and the Environment.* Statistics Canada (Ottawa K1A 076), 1978. Paperback, 183 pp. $2.80 ($3.40 outside Canada).

Presents statistical data detailing human activities which have potential for imposing stress on the natural environment. Chapters organize data for watersheds, agriculture, forests, fisheries, transportation, manufacturing and energy.

Toffler, Alvin. *Future Shock.* New York: Bantam Books, 1970. Paperback, 505 pp. $2.95.

Energy

We often think of energy as a "resource" but overlook the fact that everything we do has an energy component. Flows of energy pervade natural and human-activity systems. To the environmental planner, energy provides a useful means of describing, explaining and measuring. For example, the energy flow through a city with its factories, automobiles and high power consumption is about 100 times greater than the energy flow through a natural ecosystem (Odum and Odum). This helps explain why urban centres put so much stress on the natural systems that must provide them inputs and absorb their wastes. Energy, economics (the basic justification for urban concentrations) and environment are interdependent.

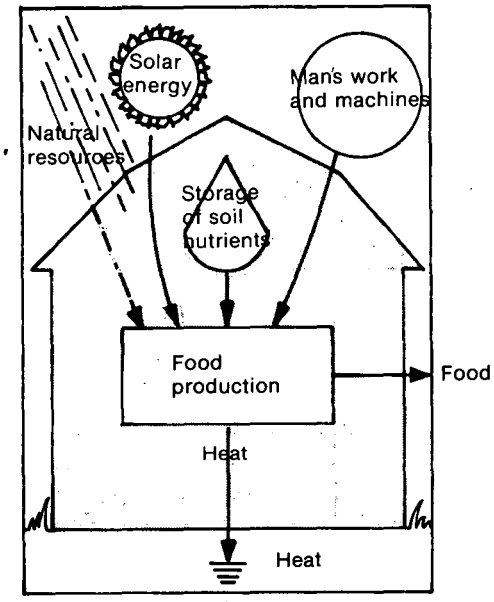


Figure 2.39 Energy Flows Necessary for a farm to Produce Food

Adapted from: Howard T. Odum and Elisabeth C. Odum, *Energy Basis for Man and Nature* (New York: McGraw-Hill, 1976).

Basic principles remind us that energy is the capacity to do work; it is the amount of stored capability for future processes. Energy comes in various forms: heat, chemical storage, electricity, magnetic, momentum of a moving vehicle, and so on. Most of it comes directly or indirectly from the sun. Energy of one kind may be transferred to another kind if there is a suitable conversion process but the energy itself is neither created nor destroyed. In all processes, however, some of the energy loses its ability to do work and is degraded in quality resulting in waste heat according to the Second Law of Thermodynamics and the concept of entropy. Energy is not consumed, but available work is; therefore, available work is what must be conserved, with emphasis on using high-quality energy appropriately (e.g., using direct heat from fuels, or better still solar energy rather than electricity, to heat water and space). Natural and man-made systems are more likely to survive if they maximize their energy inflow and make effective use of it. This can be done by storing high-quality energy, feeding back work from storage to increase inflow, recycling materials, organizing mechanisms to keep the system adaptable and stable, and setting up exchanges with other systems to supply special energy needs.

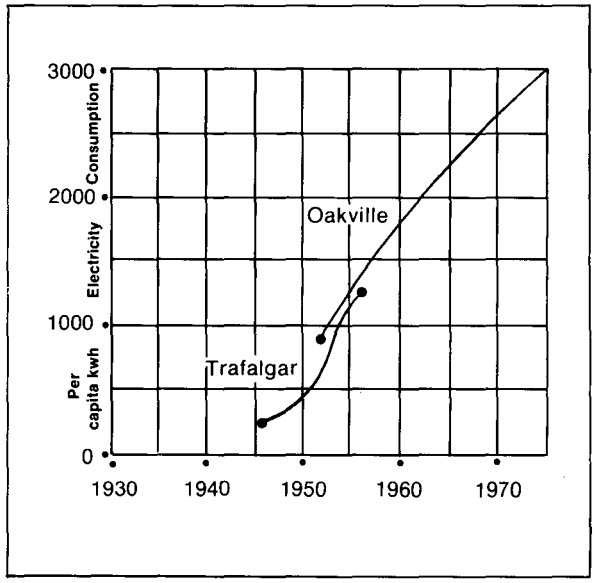


Figure 2.40 Energy Consumption in Canada from the 1930s to the 1970s: An Example

Source: Reg Lang and Audrey Armour, *Oakville Environmental Report: A Case Study in Environmental Planning* (Toronto: Lang Armour Associates, 1977). The community is the town of Oakville, Ontario, whose population rose from less than 10 000 in the 1930s to nearly 70 000 today. Electricity consumption was calculated from figures supplied, for the Town and the Township of Trafalgar which Oakville annexed in 1961, by Ontario Hydro, Oakville Consumer Service and the Census of Canada. Note the sharp rise in per capita use of electrical energy just after the War.

Energy available for human use is either renewable or non-renewable. Renewable energy is obtained by diverting part of the numerous natural energy flows. The daily cycle of potential energy in river systems, the forest regeneration cycle, the tidal cycle, and differences in pressure which create winds are examples of natural energy flow. Non-renewable energy comes from sources of energy trapped in nature and often available in highly concentrated form. Fossil fuels, the prime example, took millions of years to accumulate but only a relatively short time to

Table 2.13 Regional Variations in Energy Supply

Province	Energy Supply	1977 Prices of Fuel for Residential Use (majority)	
		Fuel Oil (¢/gal)	All electricity (¢/kwh)
Newfoundland	Heavily dependent on hydroelectric; oil for space heating. Offshore oil, gas potential.	51.1	2.42
Prince Edward Island	All electricity generated from oil. Pursuing renewable sources.	51.7	4.21
Nova Scotia	63% dependent on imported oil for electricity. Switch to coal possible. Offshore oil, gas potential.	47.8	3.40
New Brunswick	Diverse electrical energy base but 34% from imported oil. Nuclear power plant under construction.	50.0	2.44
Quebec	Heavily dependent on external sources: oil from Western Canada and foreign; gas from Alberta. Hydroelectric (James Bay) prominent.	48.6	1.76
Ontario	80% dependent on outside sources. Nuclear power gaining prominence.	49.2	2.23
Manitoba	Hydroelectric for electricity, Alberta oil and gas for the rest. Nuclear under consideration.	47.7	2.02
Saskatchewan	Virtually self-sufficient in energy (oil, gas, coal)	47.7	2.11
Alberta	Canada's major energy exporting province; substantial reserves of oil, gas, coal.	46.7	2.08
British Columbia	Diversified energy bases (gas, oil, coal, hydro)	49.6	2.32
N.W.T.	Oil and gas potential but oil presently imported.	100.6	4.01
Yukon	Hydroelectric potential. Oil imported.	61.9	3.58

Source: Canadian Secretariat, ECE Seminar, *Habitat and Energy in Canada* (Ottawa: Ministry of State for Urban Affairs, 1977).

exhaust. A major concern is that Canadians and their economy depend heavily on non-renewable forms of energy which must be imported at increasingly higher prices and which appear to be nearing the point of depletion (the extent to which this is true and the timing are debatable, and the severity of this problem varies considerably from one region to another).

While some trends point to reduced energy consumption, others suggest the reverse. Canada has a high unemployment rate which will continue to generate pressures for job creation though economic growth, in turn requiring exploitation of energy "resources". At the same time more double-income families means more people able to enjoy increased consumption. The Canadian lifestyle (for most Canadians, that is) emphasizes highly energy-intensive consumption. For example, per unit of GNP we consume nearly twice as much energy as Sweden which enjoys a similar standard of living.

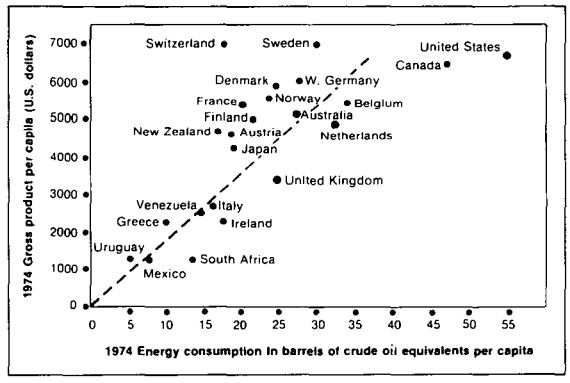


Figure 2.41 Energy Consumption by Country

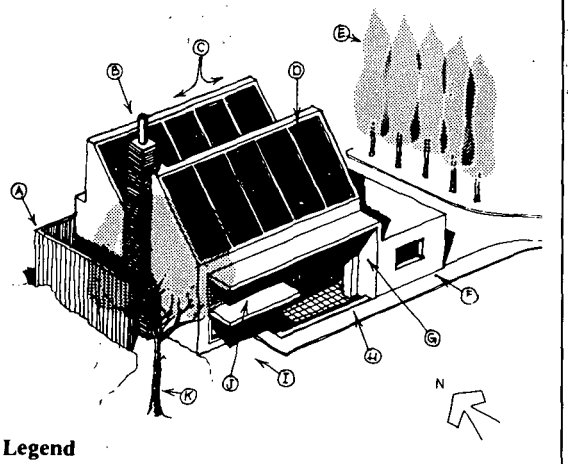
Source: Canadian Secretariat, ECE Seminar, *Habitat and Energy in Canada* (Ottawa: Ministry of State for Urban Affairs, Oct. 1977).

Energy policy for Canada's future is still evolving, both nationally and provincially. Choices varying across the country include one or a combination of: continued dependence on oil and gas (increased exploration, improved recovery technology, etc.); a shift to coal; substantial and rapid reduction in the demand of energy alongside intensive conservation programs; nuclear

energy (initially using uranium-fueled CANDU technology but eventually shifting to fuel reprocessing and the thorium cycle) with increased use of electricity; and the "soft" path emphasizing simpler, localized systems based mainly on renewable resources, alongside demand reduction and conservation. One concern is that unless substantial resources are directed toward developing the latter option, its full potential will be lost by default to massive expenditures on increased exploration for fossil fuels and nuclear power.

Each option has its own set of environmental impacts (see 4.7 Energy Projects) as well as its unique implications for the nature, intensity and pattern of human activities, settlement patterns, for example. The near future is likely to bring demands for less reliance on long trips, especially by automobile, higher residential densities, more energy efficiency in buildings, district heating and co-generation, more recycling, more emphasis on durability, less waste accompanied by increased use of what is now regarded as waste (e.g. forest waste used to produce methanol), increasing emphasis on conservation and use of non-renewable forms of energy whether the "soft-path" is adopted or not and throughout the demand for lifestyle changes.

Opportunities exist to incorporate such measures into planning, design and management processes at all levels: from the specific site where orientation of buildings, minimizing of shadowing of nearby buildings, maintenance of "solar rights", use of vegetation and other measures can significantly affect energy consumption; through various intermediate levels to the large scale where today's decisions on patterns and densities of development and transportation linkages will play a major role in future energy consumption.



Legend

A Wind shelter to SW NW
B Heating at SW corner
C Orientation — W, SW — E, NE
D 55°-60° slope for solar collectors
E Wind shelter to E, NE
F Garage on SE corner opens to sheltered E side
G Wind screen and winter sun trap
H Sheltered access on SE corner
I Opens to SE, S for midsummer lake breezes
J Shades screen sun at high summer angle but not at low winter angle
K Deciduous shade tree at SW corner

Figure 2.42 The Energy Optimal House

Source: Central Waterfront Planning Committee, *Environment Information Base* (Toronto: City of Toronto Planning Board, 1976), Section 5.4, Climate, reproduced with permission. Shown are special considerations required in the planning and design of buildings located on the Toronto waterfront with its unique climate. The two main principles are exposure to sunlight in winter but not in summer, and shelter from strong winds but exposure to cooling summer breezes.

Case Study 31
Federal Plan to Encourage Use of Solar and Waste Energy

In June 1978 the federal Ministry of Energy, Mines and Resources announced a plan to spend $380 million over the next five years on incentives to make more use of energy from the sun and from forest waste. The hope is that as much as 10% of Canada's energy will come from these sources by the year 2000, and that an unsubsidized solar industry may emerge within the next five years.

The solar incentive program comprises: preferential purchasing of Canadian-made solar space and water heating equipment for new federal buildings; research; competitions with prizes for manufacturers of solar equipment for the best designs of energy efficient buildings; and federal-provincial-industry demonstrations. The second program, to convert waste to energy, involves incentives to forest producers to develop methods for replacing oil and gas with fuel from wood waste, loan guarantees to help build electrical generation units using biomass conversion and co-generation, and federal-provincial research assistance for innovative technologies. The government expects both programs to generate additional employment.

Initial reaction to the program, while noting that the dollar amounts are small, was favourable.

See: *Globe and Mail*, 5 June 1978, and background paper from the Department of Energy, Mines and Resources (Ottawa K1A 0E4).

Case Study 32
A Solar Society by 2020?

A report recently prepared by the U.S. Council on Environmental Quality, Executive Office of the President, gives an optimistic view of the promise and progress of solar energy. Based on an extensive literature review and discussions with solar experts, the report gives an overview of the prospects for solar energy in the U.S. into the next century and examines solar energy development (solar thermal, photovoltaic cells, biomass, wind, small-scale hydropower, ocean thermal, other renewable technologies, energy storage). It concludes that with enough effort, the U.S. can meet up to one-quarter of its energy needs through solar technology by the year 2020 and become a solar society (providing significantly more than half its energy from solar sources) beyond 2020. The report discusses strategies for getting from here to there including: expanding financial incentives and eliminating institutional barriers; adopting needed changes in the federal solar resource and development program; instituting price reform for competing fuels; developing the solar market in less-developed countries; and improving government programs for the purchase of solar equipment for federal use. The key question is time: how quickly can the potential of solar energy be developed?

Source: Council on Environmental Quality, *Solar Energy: Progress and Promise*, CEQ (722 Jackson Place NW, Washington, DC 20006), April 1978, 52 pp. Free.

Information Resources

See also:
1.3 The Nature of Environmental Problems
2.2 Climate
2.2 Radiation
2.7 Natural Systems and Processes
2.7 Natural Environments and Human Activities
4.7 Energy Projects

American Society of Landscape Architects Foundation. *Site Planning for Solar Energy Utilization.* National Bureau of Standards, U.S. Dept. of Commerce and U.S. Dept. of Housing and Urban Development, Office of Policy Development and Research (Washington, DC 20410), 1975.

Anderson, Bruce and Rirdan, Michael, *The Solar Home Book.* Harrisville, NH: Chesire Books, 1976. $8.50.

A guide to heating, cooling and designing with the sun.

Argue, Robert. *Renewable Energy Resources: A Guide to the Literature.* Dept. of Energy, Mines and Resources (Renewable Energy Resources Branch, 580 Booth St., Ottawa K1A 0E4), 1977. Free.

Argue, Robert, Emanuel, Barbara and Graham, Stephen. *The Sun Builders: A People's Guide to Solar, Wind and Wood Energy in Canada.* Renewable Energy in Canada (415 Parkside Drive, Toronto M6R 2Z7), 1978. Paperback, 254 pp. $7.50.

A state-of-the-art review of renewable energy (solar, wind, wood) in Canada. Includes descriptions of the work of over 70 "pioneers" and their innovative energy systems, provides a consumers' guide to the field including a catalogue of Canadian manufacturers and distributors of hardware, and lists information sources.

Berkowitz, M.K. *Implementing a Solar Technology in Canada: The Costs, Benefits and Role of Government.* University of Toronto, Institute for Policy Analysis (150 St. George St., Toronto M5S 1A1), May 1977. 239 pp. Free.

Burchell, Robert W. and Listokin, David (eds.). *Future Land Use: Energy, Environmental and Legal Constraints.* Rutgers – The State University, Center for Urban Policy Research (Building 4051, Kilmer Campus, New Brunswick, NJ 08903), 1975. Hardcover, 369 pp. $17.95

Papers in this volume cover land use and growth, growth vs. the environment, energy constraints and growth, and the shape of metropolitan areas in the year 2000. Annotated further in 5.7 Regulation and Review.

Bureau of Municipal Research. *What Can Municipalities Do About Energy?* BMR (2 Toronto Street, Suite 306, Toronto M5C 2B6), March 1978. 47 pp. $2.00.

This report attempts to demonstrate that municipalities have a major role to play in promoting the prudent and efficient use of energy. Four areas for municipal action are emphasized: land use and transportation planning, building and site design requirements, development of local renewable energy sources, and public education and demonstration programs. In each area, the report looks selectively at opportunities for and barriers to municipal initiatives.

Canada. Department of Energy, Mines and Resources. *An Energy Strategy for Canada: Policies for Self-Reliance.* Supply and Services Canada, Printing and Publishing (Ottawa K1A 0S9), 1976. 170 pp. $2.50 ($3.00 outside Canada). Also available from the Department: *An Energy Policy for Canada – Phase 1, Volumes I and II,* 1973. $10.00.

Canada. Department of Energy, Mines and Resources, Office of Energy Conservation. *District Heating for Small Communities.* OEC (Ottawa K1A 0E4), Jan. 1977. Free.

The Office has available a large array of free publications on energy conservation. Another reference on district heating is: Edward L. Morofsky, "District Energy Options", *Urban Forum* (Canadian Council on Urban and Regional Research, 251 Laurier West, Suite 1100, Ottawa K1P 5J6, $2.50 per issue or $15 per year), Vol. 3, No. 4, 1977, pp. 10-19, which also includes further sources. See also: Morofsky, *An Ecological Framework for Evaluating the Urban Impact of District Energy Systems,* Public Works Canada, Technological Research and Development Branch, Engineering Construction Design Performance Division (Ottawa K1A 0M2), Oct. 1976, 35 pp.

Canadian Secretariat, ECE Seminar. *Habitat and Energy in Canada.* Ministry of State for Urban Affairs, Information Resource Service (Ottawa K1A 0P6), 1977. 101 pp. Free.

This report was prepared for the U.N. Economic Commission for Europe's Seminar on "The Impact of Energy Considerations on the Planning and Development of Human Settlements" in Ottawa, October 1977. A profile of Canda sets out the political/institutional framework, geographic setting and supply/demand picture for energy and settlement policies and plans. The report then examines the historical relationship between decisions in Canada; discusses approaches to adaptation (adjusting old and new settlement forms, conserving energy in buildings, opportunities in energy design and form as well as in transportation, innovative technologies, and examples of government action); looks at economic, capital and institutional constraints on adaptation and speculates on future demographic and economic prospects for Canada; considers options for energy and settlement (more of the same, reducing demand and intensifying conservation, shifting to coal, nuclear power, and the "soft" energy path); and lays out some implications for planners.

Carroll, T. Owen et al. *Land Use and Energy Utilization. Interim Report.* Stony Brook, NY: BNL/SUNY Land Use-Energy Utilization Project, October 1975. Also: *A Brief Summary of the Land Use and Energy Utilization Project. Informal Report.* Dec. 1975. *The Planner's Energy Workbook. A User's Manual for Exploring Land Use and Energy Utilization Relationships.* Oct. 1976. *Land Use Energy Simulation Model. A Computer-Based Model for Exploring Land Use and Energy Relationships.* Sept. 1976.

This project represents an initial effort to formulate and test both an analytical framework and a data base of land use-energy intensity factors which will lead to an improved understanding of the interdependencies between new land use activities and local and national systems of energy supply, distribution, and consumption. There are four specific goals: to improve the generic understanding of the relationship between land use and energy utilization; to establish a method and the technical information for the derivation of the energy demands associated with alternative land use policies; to assess the influence of a selected set of energy conserving measures on total energy demand in a region; and to provide local, regional and state land use planners with a data base and a set of procedures for incorporating energy conservation considerations into their choices and decisions with respect to future land use. The Workbook overviews some potential procedures that can be used by local planners to carry out community and regional energy analyses. It focuses on the relationship between energy use characteristics and such planning concepts

as land use, density, type of residential development, commercial floorspace, industrial sales and employment, and shopping and work trip lengths. Carroll emphasizes that the purpose of the land use energy analysis is not to determine energy "optimal" land use configurations but to assess the impact of a variety of designs and plans on the energy system and vice versa. The Workbook provides basic information on energy intensity factors in the major land use sectors to take into account local conditions and presents illustrative case examples of the use of the workbook approach. Application of the work since 1975-76 is unknown.

Clark, John. *The Sanibel Report: Formulation of a Comprehensive Plan Based on Natural Systems.* The Conservation Foundation (1717 Massachusetts Ave. NW, Washington, DC 20036), 1976. Paperback, 305 pp. $9.00.

Appendix 6, "Natural Energy Systems" by Mark Brown, pages 297-305, uses energy to calculate carrying capacity of this 11 000 acre barrier island on the Gulf Coast of Florida. Sanibel's natural energy from sun, water and wind provides the basis for an environment that attracts visitors and dollars in turn allow the island to purchase additional outside energy (electricity, oil and gas, goods, materials) to sustain the desired lifestyle. The island's environmental resources and ability to pay limit its further growth, however. A model, constructed using energy flows, determined that Sanibel could allow a total average yearly occupancy of 13 300 people on the island (9 200 permanent visitors and 125 000 tourists staying for 12 days). Guidelines for achieving a steady-state economy are presented. The entire report is annotated further in 5.4 Plans.

Charsley, Peter. *Energy in Urban Systems: A Strategy for the Study of Energy Implications of Urban Services.* Ministry of State for Urban Affairs (Ottawa K1A 0P6), Aug. 1975.

After a thorough review of the literature, Charsley concludes that it is unclear whether urban planning for growth or revision of urban form is compatible with energy solutions. It cannot be stated, for example, that urban location or sprawl are causes of energy problems. Nevertheless, Charsley agrees it may be possible to affect consumption through overall growth, changes in economic mix, changes in density, and changes in urban form (i.e., residential/industrial/commercial mix as well as mix of multi-family and single-family dwellings).

Commoner, Barry. *The Poverty of Power: Energy and the Economic Crisis.* Toronto: Bantam Books, 1977. Paperback, 297 pp. $2.75.

A penetrating analysis of the complex interconnectedness of energy development, environmental degradation and economic decline. Commoner argues that there is a built-in conflict between the biology of the ecosystem and the thermodynamics of present energy sources; that the energy system has a propensity toward inflation which in the long run will have a major impact on the economy as a whole; and that the design of the system which governs how wealth is produced, distributed and used is itself the fundamental cause of the current economic crisis as well as the crisis in energy and environmental quality.

Conserver Society Notes. Published quarterly by Alternatives, Inc. (P.O. Box 1097, Station C, Downsview, Ontario, M3N 35B), $5.00 per year ($3.00 for students).

Cook, Earl. *Man, Energy, Society.* San Francisco: W.H. Freeman, 1976. 478 pp. $7.95.

A historical and geographical overview presenting the physical, biological and social costs of present energy use. The book points out the necessity of using renewable energy sources while moving toward a society of "affluent scarcity".

Energy Probe. *New Energy Sources for Today.* Toronto: Coles Books, 1978. Paperback, $5.95.

Energy Probe. *The Renewable Energy Handbook.* Energy Probe (43 Queen's Park Crescent East, Toronto M5S 2C3), 1976. 51 pp. Available from Coles, $4.35.

Environment Canada, Atmospheric Environment Service. *New Estimates of Average Global Solar Radiation in Canada.* Atmospheric Environment Service (4905 Dufferin Street, Downsview, Ont. M3H 5T4), July 1969.

Environmental Comment, July 1977 (Urban Land Institute, 1200 18th St., NW, Washington DC 30036).

Special issue with nine articles devoted to energy conservation and land development, including case studies.

Florida State Dept. of Administration. *A Planner's Handbook on Energy (With Emphasis on Residential Uses.)* The Dept. (State Energy Office, 108 Collins Bldg., Tallahassee, Fla. 32304), Nov. 1975. 270 pp. $4.50, cheque payable to State of Florida, Dept. of Administration.

Chapters of general relevance cover energy consumption in single-family dwellings, transportation to and from, new ideas and technology, legislative alternatives, pollution/waste and land use, and energy/environment issues and urban growth. Solar energy is included.

Foster, Harold D. and Sewell, W.R. Derrick. *Solar Home Heating in Canada: Problems and Prospects.* Environment Canda, Office of the Science Advisor (Ottawa K1A 0E3), Report No. 16, 1977. 226 pp.

Reviews the Canadian scene including technologies, diffusion of use, roles of various groups in promotion, performance barriers and incentives.

Gill, Efrain. *Energy-Efficient Planning: An Annotated Bibliography.* American Society of Planning Officials (1313 East Sixtieth Street, Chicago, IL 60637), 1976. 23 pp., $6.00.

Annotated in 4.2 Urbanization.

Harwood, Corbin Crews. *Using Land to Save Energy.* Cambridge, MA: Ballinger Publishing Co., 1977. Hardcover, $15.50.

Hix, John. *Energy Demand for Future and Existing Land Use Patterns.* Royal Commission on Electric Power Planning (14 Carlton St. Toronto M5B 1K5), Oct. 1977. 94 pp. + app. Free.

Examines ways to reduce energy consumption through more efficient land use, development patterns and building design. Various examples and test cases are presented and barriers to energy and food conservation are discussed. The appendix includes conclusions and recommendations of the ECE Seminar referred to under Canadian Secretariat, above.

Hollands, K. and Orgill, J. *Potential for Solar Heating in Canada.* University of Waterloo Research Institute (Waterloo, Ont. N2L 3G1), Feb. 1977, 102 pp.

IBI Ltd. *Energy Conservation Through Land Use Decisions.* Environment Canada (Ottawa K1A 0H3), March 1976. 65 pp.

Discussion paper reviewing the relationship of energy considerations to land use planning, and identifying potential for land use policy and practice to influence patterns of energy consumption.

Kreider, Jan F. and Kreith, Frank. *Solar Heating and Cooling: Engineering, Practical Design and Economics.* Revised First Edition. New York: McGraw- Hill, 1975. Hardcover, 342 pp. $22.50.

Love, Peter and Overend, Ralph. *Tree Power: An Assessment of the Energy Potential of Forest Biomass in Canada.* Department of Energy, Mines and Resources, Renewable Energy Resources Branch (Ottawa K1A 0E4), 1978. 53 pp.

Forest biomass as a renewable energy source is reviewed within the framework of a long-range energy review to the year 2015. Principal conversion technologies are discussed and three reference cases are investigated (electricity generation, methanol production and low BTU gasification). The report then examines the supply of forestry biomass in Canada, potential applications for energy that could be derived from it, and factors significant to implementing such a program with special attention on costs. The report concludes that although data on the availability of the resource are severely lacking, considerable potential exists to develop "tree power" in Canada, especially in the near future, by using mill residue to substitute for fossil fuel in existing forest industries. In the longer term, forests could provide a large proportion of carbon-based fuel requirements but a development program including environmental impact analysis will be needed (e.g., collecting forest residue could strip the soil of nutrients). A major resource assessment of forest biomass is recommended as top priority. See also: C.C. Burwell, "Solar Biomass Energy: An Overview of U.S. Potential", *Science* 199, March 1978, pp. 1041-1048, concludes that the use of wood fuel for small-scale heating is an important near-term opportunity.

Contact:
The Biomass Energy Institute
304-870 Cambridge St.,
Winnipeg, Man. R3M 3H5.

Lovins, Amory. *Soft Energy Paths: Toward a Durable Peace.* Cambrige, MA: Billings Publishing Co., 1977. Available from Environmental Action Reprint Service (2239 East Colfax, Denver, CO 80206). Paperback, 234 pp. $6.95.

Lovins, a key international figure in the energy conservation movement, addresses the question: who needs how much of what kind of energy for what purpose for how long? His analysis suggests a different path towards which energy systems can evolve. See also his earlier, influential article, "Energy Strategy: The Road Not Taken?" *Foreign Affairs*, Oct. 1976. pp. 65-96; and "Exploring Energy – Efficient Futures for Canada", *Conserver Society Notes* (Science Council of Canada), Vol. 1, No. 4.

McCallum, Bruce. *Environmentally Appropriate Technology.* Environment Canada, 1977. Paperback, 155 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $3.75 ($4.50 outside Canada).

Subtitled "Renewable Energy and Other Developing Technologies for a Conserver Society in Canada", this report examines all aspects of renewable energy, then looks at environmentally appropriate housing, industry, agriculture and transportation.

Middleton Associates. *Canada's Renewable Energy Resources: An Assessment of Potential.* Middleton Associates (980 Yonge Street, Toronto M4W 2J9), 1976. 514 pp. $20.00.

Middleton Associates. *Energy Management at the Local Level.* Royal Commission on Electric Power Planning (14 Carlton St., 7th Floor, Toronto M5B 1K5), 1978. 44 pp. + 45 p. appendix.

Using Oakville, Ontario (pop. 60 000) as a case study, this report identifies current energy use patterns (an energy profile in Oakville is included, along with discussion of the method used), samples local attitudes to energy-saving opportunities, and looks at the feasibility of various local measures (by householders, residential and commercial property managers and developers, industrial plants, housing developers, municipal government) designed to maximize energy saving from these opportunities.

Odum, Howard T. and Elizabeth C. *Energy Basis for Man and Nature.* New York: McGraw-Hill, 1976. Paperback, 297 pp. $8.75.

This book aims at a simple presentation of the principles of energy and how they shape culture. It sets out basic laws of energy in a systems perspective, flows of energy in the environment, how energy systems support human activities, and prospects for the future amidst an "energy crisis". More elaborate discussion of these topics is given in Odum, *Environment, Power and Society* (New York: Wiley – Interscience, 1971), paperback, 333 pp.

Ontario Ministry of Education. *Energy in Society: A Resource Guide for Teachers.* Toronto: The Ministry, n.d. (about 1978). 210 pp. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $5.00, cheque payable to Treasurer of Ontario.

A useful reference for educators looking for ideas on how to develop an energy conservation ethic in students and also for planners and citizens. Organized in five parts: Introduction, which defines energy and systems, puts energy into its global and national contexts, then discusses energy and home systems, controlling energy demand and slowing down the system; Space Heating; Electrical Energy; Water; and Food. Each section includes background information, student activities and a bibliography.

Ontario Ministry of Energy. *Turn on the Sun.* The Ministry (Information Office, 56 Wellesley St. West, Toronto M7A 2B7), 1977. 44 pp. Free.

Explains solar energy, putting the sun to work, deciding to go solar, and choosing a solar system. Included are case histories of nine solar projects in Ontario plus information resources on solar energy.

Pearson, Norman. *Food Land and Energy Planning.* Food Land Steering Committee (c/o Lloyd Moore, P.O. Box 6, Listowel, Ont.), 1976. 2 volumes.

Annotated in 4.1 Agriculture.

Regional Municipality of Hamilton Wentworth, Planning and Development Department. *Energy Consideration in Urban and Regional Planning.* The Department (P.O. Box 910, 100 Main St. East, Hamilton, Ont. L8N 3V9), Jan. 1978. 29 pp. + app.

Discusses the need for energy conservation, opportunities for energy conservation in building design and planning, legal aspects of direct use of solar energy, and special considerations at the municipal/regional scale. Extensive appendices are included on detailed technical aspects of the foregoing.

Robinette, Gary (ed.) *Landscape Planning for Energy Conservation.* Environmental Design Press (P.O. Box 2187, Reston, VA 22020) 1978. $20.00

Prepared for the U.S. Departments of Commerce and H.U.D. by the America Society of Landscape Architects Foundation, this book responds to three perceived needs: "for proper landscape planning from the new perspective of energy conservation, for understanding of the abilities of natural elements to assist in utilizing the unlimited solar energy striking the earth, and for a sensitivity of the abilities of natural elements to control or embrace architectural and engineering methods to utilize more efficiently and effectively existing energy resources". Subjects covered include climatic impact of natural elements (land and landforms, vegetation), climatic regions and human adaptation, site analysis process and techniques, site selection, building siting and orientation, integration of building and site, site planning and design, selection and use of site elements including natural elements (vegetation, earth forms, water) and non-usable elements (vertical, horizontal, architectural), site accommodation of solar collection units, and redesigning existing sites for improved energy utilization.

Saxe, Dianne. *Perspectives on Access to Solar Energy.* Ontario Ministry of Energy (156 Wellesley St. West, Toronto M7A 2B7), 1978. Available from Government of Ontario Bookstore (880 Bay Street, Toronto M7A 1N8) $2.00, cheque payable to Treasurer of Ontario.

A report on legal aspects of the right to light.

Science Council of Canada. *Population, Techonology and Resources.* Ottawa: The Council, Report No. 25, July 1976. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9). $2.50.

Includes a brief and pessimistic analysis of Canada's energy situation to the year 2001. The report argues for energy conservation, first because it provides the greatest short and medium-term leverage in combating possible shortages, and second, because initially, conservation will be less expensive then providing new energy. The Council suggests that the environmental costs of getting fossil fuels to Canada's southern markets from the North could be the ultimate constraint in developing new potential fossil fuel sources.

Solomon, Larry. *The Conserver Solution.* Toronto: Doubleday, 1978. Paperback, $6.95.

Thorndike, Edward H. *Energy and Environment: A Primer for Scientists and Engineers.* Don Mills, Ontario: Addison-Wesley Publishing Company, 1976. Paperback, 286 pp. $8.95.

Intended to equip the intermediate-level student and working professional with a broad overview of the field of energy and environment. Natural energy processes (global energy flows, weather and climate, photosynthesis, food chains) are covered in addition to man-initiated energy processes such as fossil fuel power, nuclear fission and hydroelectricity. Thermal pollution, radioactivity and air pollution are the main environmental problems examined.

Valaskasis, Kimon et al. *The Selective Conserver Society. Vol. 1: The Selective Conserver Society.* $18. *Vol. 2: The Physical and Technological Constraints.* $20. *Vol. 3: The Institutional Dimension.* $20. *Vol. 4: Values and the Conserver Society.* $20. GAMMA (Suite 210, 3535 Queen Mary Ave., Montreal) 1976. Availability uncertain.

Warren, Betty. *The Energy and Environment Bibliography: Access to Information.* Revised Edition. Friends of the Earth Foundation (124 Spear St., San Francisco, CA 94105), April 1978. Paperback, 100 pp. $3.50.

Extensive up-to-date well-organized annotated bibliography. Also available from FOE: *Sun! A Handbook for the Solar Decade*, 1978, $2.95; and *Progress As If Survival Mattered*, 1978, $6.95.

Chapter 3

3. Selected Environments



3.1 Streams and Valleys

People usually do not think of the environment as air or water or wildlife. Their experience of their environments (neighbourhoods, parks, beaches, ravines, etc.) is more integrated. Various institutions similarly focus on whole environments rather than their components. The Great Lakes Water Quality Board and Ontario's Conservation Authorities whose boundaries are watersheds, are prominent examples. Public concern often focuses on specific environments as well; for instance, cottage owners on a lake contaminated with sewage, conservationists fighting to protect a marsh and agriculturalists worried about loss of a prime land.

Seven classes of environment receive attention in this chapter. Three are water-related (rivers/streams/valleys, inland wetlands, lakes), three are often the subject of conflict and controversy (coastal zone, urban fringe, scenic resources), and the last covers assemble environments that are particularly sensitive to human activity. Each class of environment is presented in terms of its functions to benefit man and what adverse consequences may result when the natural systems are subjected to undue stress.

One of the distinguishing features of the Canadian landscape is its incredibly complex network of brooks, creeks and rivers (collectively referred to here as streams). An important natural endowment, these watercourses:

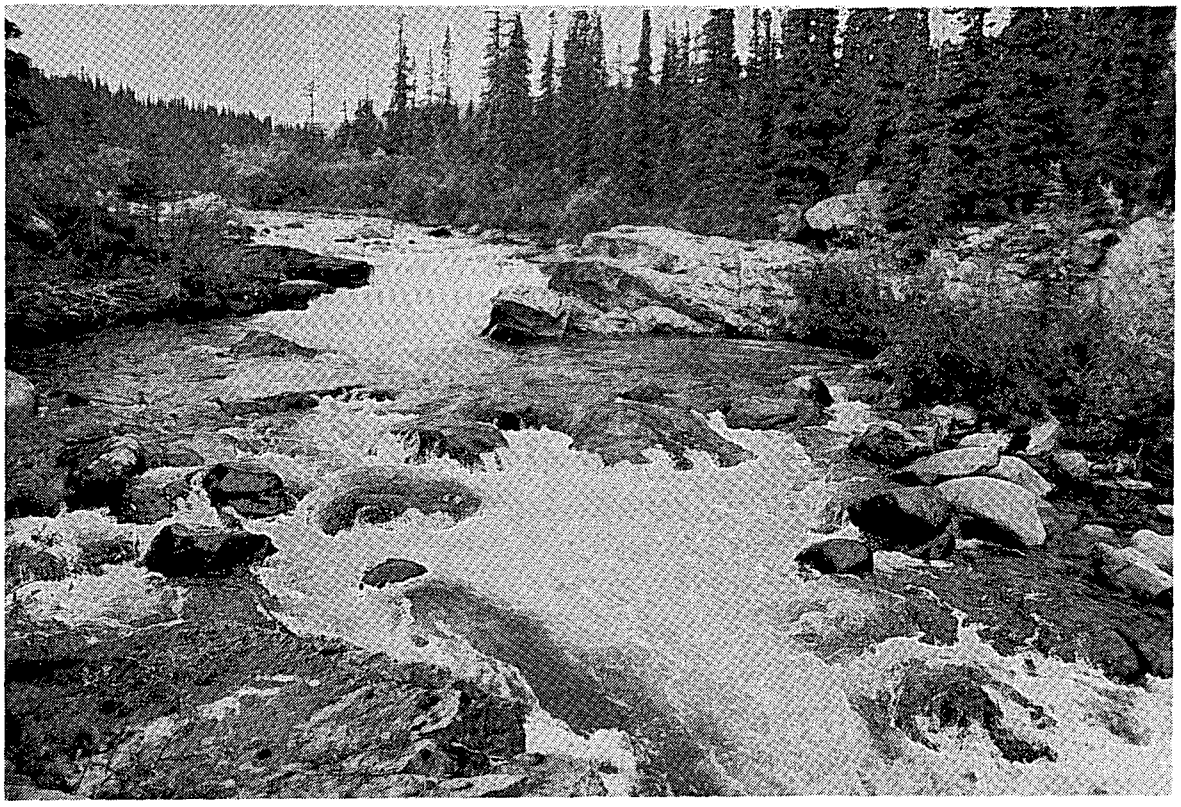
Affect the amount of water available for human use. Many communities get their water from wells drilled into groundwater reservoirs. Streams and aquifers form interlocking systems. Aquifers may discharge groundwater into streams during low flow; during the wet season infiltration from streams replenishes or recharges the aquifer.

Determine the quality of water. A large amount of waste from industrial, agricultural and urban activities eventually finds its way into stream channels. Within limits, streams can purify themselves by biological action and physical processes. Sunlight acts upon some waterborne pollutants while others are broken down by bacteria or settle to the streambed.

Acknowledgements 3.1

This section includes contributions from:

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Serve as major conduits for nutrients and sediments. Flowing water carries nutrient to and wastes away from aquatic organisms. Sediments are deposited in low-lying areas and other water bodies, creating floodplains and deltas. Because floodplains are enriched by nutrients and sediments from periodic flooding, they offer some of the most productive agricultural lands.

Provide habitat. Streams and valleys nurture wetlands and provide breeding, maturing, watering and feeding areas for many species of fish, waterfowl and other wildlife.

Have considerable recreational potential. Watercourses provide a wide range of opportunities for recreation, especially within urban areas.

- *Enhance property values.* Too often this is the main value seen in streams, and too often the value gained is private.
- *Contribute directly to the quality and livability of human settlements.* An aggregate of the foregoing.

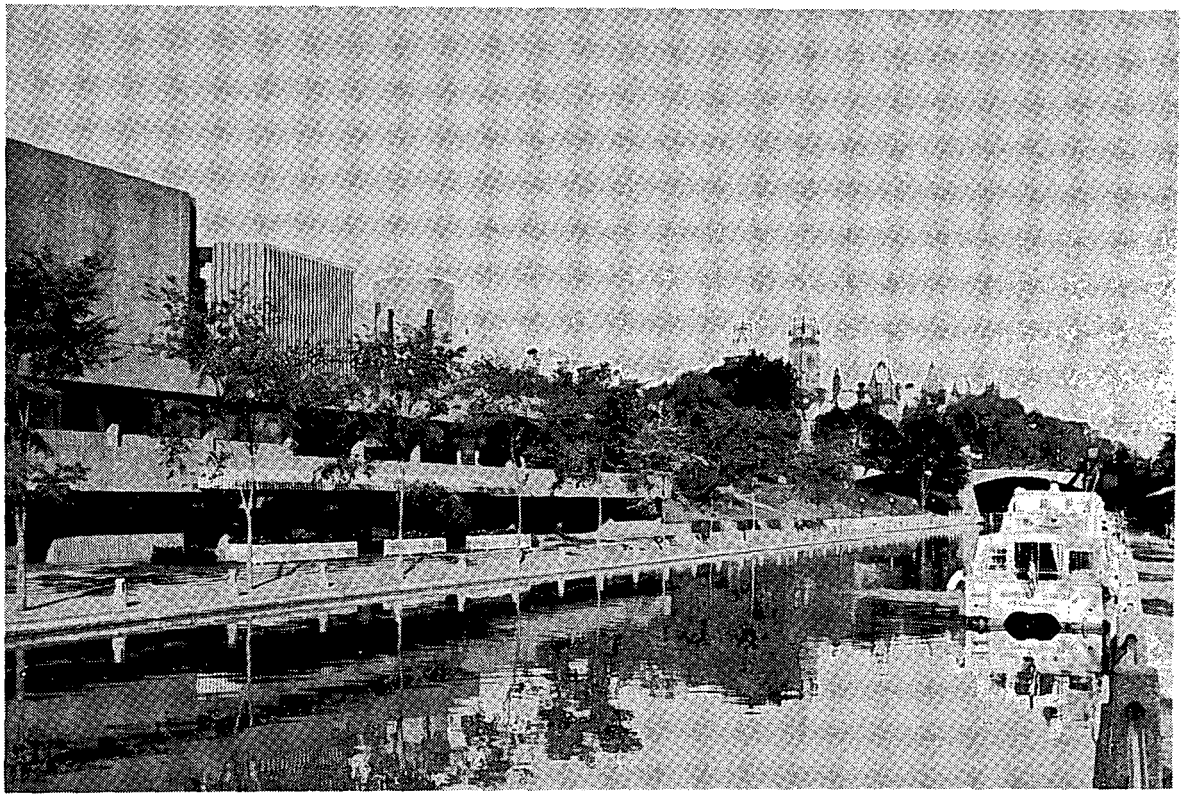
Because much of the Canadian landscape is relatively unpopulated, many Canadian streams remain in their natural state. In areas where most Canadians live or where there is intensive human activity, the adverse impacts of man are very evident. On the other hand, Canadian communities tend to turn their backs on the valuable stream resource, which makes adverse impacts not as apparent as they could and should be. Three kinds of impacts are common and widespread; they often take time to become noticeable but they may be cumulative and even irreversible.

The first impact is increased sedimentation caused by runoff and erosion from farm lands, highways, logging, construction sites and other areas where topsoil has been exposed and vegetative cover has been removed. Heavy sediment loads can raise flood levels, block connections with aquifers and change stream corridors. Silt can change a cold, clear trout stream to a warm, murky one, altering fish habitat and killing certain aquatic organisms. As well, the suspended materials block out light and prevent growth of aquatic plants. When the silt settles to the bottom, it can trap sewage and other organic material and smother eggs and bottom organisms.

Pollution is the second impact. Stream pollutants fall into five categories: organics (human sewage, animal manure and vegetable wastes, all of which require oxygen for decomposition), toxicants (heavy metals, phenol, DDT), eutrophication (a natural aging process but a problem when accelerated by the addition of commercial fertilizers and detergents), waste heat and radioactivity.

The third and perhaps most pervasive effect of man on streams has been to *change their peak or base flows* (see 2.3 Urban Runoff). The character of a stream and the life within it are determined to a large degree by the velocity of the current. The rate of flow of stream waters influences the degree of silt deposition, the nature of the stream bottom and the dispersal of nutrients and wastes. Dredging and straightening of streams for flood control can significantly change stream dynamics and aquatic systems. Newly-cut channels, designed to hasten the flow of water, support little bottom fauna. Fish migrate to other areas because of lack of food, shelter and breeding sites. Dams can interrupt the natural regime of stream flow by curtailing floods; without periodic floods, adjacent wetlands will deteriorate and important wildlife habitats may be lost. In rural agricultural areas the extensive drainage systems can also contribute to flooding by increasing runoff, perhaps generating demands for dam construction. Urban development in the watershed also alters stream flow by increasing the amount of runoff reaching the streams. Roads, buildings, and other impervious surfaces accelerate runoff. Removal of vegetation and destruction of wetlands further increase its rate. With more runoff passing quickly down the stream and less water percolating though the soil into the underground reservoirs, groundwater reserves will be lowered, flooding more frequent and erosion more pronounced. Storm water retention schemes serve the purpose of reducing the amount and rate of runoff reaching watercourses, but if improperly carried out they can create further problems of erosion, pollution and habitat disturbance.

The combined effect of the three foregoing impacts is to fundamentally change the nature and function of a stream. A natural watercourse, offering habitat and amenity, is transformed. As pollution and siltation change the balance of life in and beside the stream, a new order of plants and animals appears. If streamside vegetation is destroyed, shading effect and food supply are lost. Warmer temperature means the displacement of certain fish species like trout, by others.



Changes in rates of stream flow and man-made structures similarly affect the habitat of fish and other aquatic and terrestrial life associated with the stream. Each of these changes in turn affects the nature of open-space amenity provided by the stream and valley. An associated factor is that the kind of open space most people prefer – "clean", open, manicured, park-like – often is not consistent with the functioning of a natural system in and adjoining a stream.

Environmental planning aims at: (a) protecting the stream resource and the functioning of the stream and valley system and (b) preventing, minimizing and mitigating the three kinds of adverse impacts. Measures include: attention to the nature and intensity of development permitted near streams; development controls, especially those using performance standards based on carrying capacities; the use of buffer zones; control over construction practices and other causes of erosion and sedimentation; careful design of sewerage and drainage systems including control structures; and large-scale planning of river basins.

Case Study 33
Flooding by the Sea, Truro, Nova Scotia
Submitted by Michael Simmons, Maritime Resource Management Service

Truro, a town of 11 000 in central Nova Scotia, is built on a low gravel terrace next to the Salmon River, a short steep stream that discharges into the Bay of Fundy. In recent years a highway, two shopping centres and other developments have occurred on the floodplain. A sudden spring thaw and rainfall in 1971 produced the "Valentine's Day" flood and triggered a controversy that continues today.

Environment Canada officials have called this "the most complicated flood situation on the Eastern Seaboard". An extensive dyked salt marsh which is flat and low in elevation (30 ft.) occurs below the level of high tide. The freshwater floodplains of the North and Salmon Rivers and other streams discharge through the dykelands. Siltation, predominantly from marine sources, causes the riverbed elevation to vary during the year and helps form ice jams during thaws. Artificial changes to the floodplain include the dykes (which exclude salt water but

retain freshwater floods), the highway embankment, extensive fill for industrial storage areas and numerous buildings.

After the 1971 flood, two studies by the Maritime Resource Management Service suggested building a causeway to exclude the salt water. Local municipalities supported this proposal but the Province did not. A subsequent flood partly demolished five houses. The Province paid the owners to relocate and the subdivision was abandoned. The Town of Truro then brought forward a Municipal Development Plan which recommended a floodplain zone. The Plan was approved but the Minister of Municipal Affairs moved the floodline farther away from the river than the Town wished. Developers have challenged this line but the Town Council has remained firm.

Only since the most recent flood in 1978, have citizens been aroused by the flooding issues. A developer's proposal for a rezoning and plan amendment to permit apartment units on extensive fill at a narrow point on the floodplain was opposed by residents.

Three weeks before the public hearing, the site flooded and public concern increased considerably. Council voted unanimously to reject the developer's proposal and to withhold consideration of any further amendments for one year. The provincial and federal governments are about to launch a new study of the situation.

This case demonstrates that development control in floodplains is a difficult and contentious matter. Without repeated flood losses and the dramatic timing of the last flood, it is doubtful whether flooding would have generated sufficient concern to cause (or allow) elected representatives to take the necessary preventive action. Though one development proposal has been blocked, the issue remains very much alive; for example, fill on the rural municipality's side of the floodplain continues, exacerbating flooding problems. The case has wider significance because it is Nova Scotia's first floodplain zone.

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Case Study 34
Great Cataraqui River Environmental Planning Study, Kingston

Submitted by Fred Curtis, Queen's University

The Great Cataraqui River separates the City of Kingston and its western neighbour, Pittsburg Township. In 1977, the School of Urban and Regional Planning of Queen's University carried out an environmental planning study aimed at: (a) researching and mapping the river valley's biophysical, socio-economic, historical, aesthetic and land-use characteristics for the purpose of indicating non-developable areas; (b) deriving a set of biophysical and socio-economic "environmental restrictors", inventoried and evaluated in the field, for the purpose of identifying potential developable areas; and (c) displaying the results on a composite map of the study area. The study used and refined a planning technique proposed in F.L. Cross et al., *Environmental Planning* (Westport, CT: Technomic Press, 1975).

The study's output map indicated ecologically sensitive and other recommended non-developable areas, and areas potentially developable for residential, commercial, industrial or recreational uses. Comparison with the Kingston and Pittsburg Township Official Plans indicated a high degree of agreement between the permitted and recommended land uses, although the latter were more specifically delineated. The study, which cost $12 000, also indicated that the environmental planning technique was relatively easy to apply in a short time (3½ months) and yielded a high degree of accuracy. The same technique is capable of application to other river valleys on the urban fringe. The composite map can be used to update an official plan or to assist in devising secondary and site plans.

See: F. Curtis and D. Christian (eds.) and GCEPS Researchers, *The Great Cataraqui River Valley Environmental Planning Study*, Queen's University, School of Urban and Regional Planning (Mackintosh-Corry Hall, Kingston, Ont. K7L 3B6), 1977, $5.00.

Case Study 35
Metro Toronto Valley Land Studies

Under the Ontario Government's "Experience 77" program (which financially assists research conducted for municipalities by university students) the Ministry of the Environment sponsored a number of studies of the valley lands in

the Metro Toronto area. The following reports, which range from a quantitative ecological analysis of sites in the area's ravines to an overview of floodplain and valley management strategies, are available on loan from the Ministry Library (1st floor, 135 St. Clair Ave. West, Toronto M4V 1P5).

Ryerson Polytechnical Institute, Applied Geography Dept. *Environmental Jurisdictions in Metropolitan Toronto.* Feb. 1978.

Ryerson Polytechnical Institute, Urban Planning Dept. *Rouge Watershed Environmental Study.* Oct. 1977.

University of Toronto, Botany and Zoology Departments. *A Quantitative Ecological Study of Toronto Ravines: Rosedale Valley, Park Drive Ravine, Moore Park Ravine and Burke Brook Ravine.* Feb. 1978.

University of Toronto, Department of Urban and Regional Planning. *Erosion on Minor Watercourses in Metropolitan Toronto.* Aug. 1977. Set of 58 maps and Final Report available at Norman Wade Co. Ltd. (1891 Yonge St., Toronto).

University of Toronto, Erindale College. *A Synthesis of Metropolitan Toronto Valley Land Studies: Anticipating Problems of Urban Encroachment.* Aug. 1977. Set of 16 official plan, zoning, ownership and potential development site maps, available at Norman Wade Co. Ltd. (1891 Yonge St., Toronto); annotated bibliography and technical appendix available at MoE Library.

York University, Geography Department. *An Examination of Floodplain and Valley Land Management Strategies and Policies in Selected Ontario Municipalities.* Sept. 1977.

Since 1973, the Toronto Field Naturalists Club (83 Joicey Blvd., Toronto M5M 2T4) has conducted a number of surveys of the ravines to provide a record of the plants and animals present and the condition of the natural features of the ravines at a specific time. Each survey pulled together information on the history of the area, current human uses, species and natural habitats. Their most recent study, *The Taylor Creek-Woodbine Bridge Ravines,* was prepared in response to two applications by Trimontium Developments to construct townhouses in the ravine area. One application was approved in 1976; the Toronto Field Naturalists contested the other unsuccessfully before the Ontario Municipal Board in April 1978. Other reports are available for the Chatsworth Ravine (1974), Brookbanks Ravine (1974), Chapman Creek Ravine (1975), Wigmore Park Ravine (1975), Park Drive Ravine (1976) and Burke Ravine (1977).

The Municipality of Metropolitan Toronto, Planning Department (City Hall, Toronto M5H 2N1) is working with various government departments and citizens groups to formulate a development policy for ravines in the metro area. Its *Draft Plan for the Urban Structure, Metropolitan Toronto* (Municipality of Metropolitan Toronto Planning Department, City Hall, Toronto M5H 2N1, 1978, $5.00) would protect and restrict use of the valley lands. Along the major river valley systems, a valley land impact zone is proposed, extending from the (flood) hazard line, or 90 m back from the crest of the slope. Plans and development proposals would have to address the capability of proposed uses to maintain the natural processes and features of the valley, topography, soil conditions, hydrology, vegetation, wildlife and scenic resources.

Some of the area municipalities in Metro Toronto have taken action on their own. See: *Report on Ravines Consolidation,* City of Toronto Planning Board (City Hall, Toronto M5H 2N2), 1973; *Etobicoke Valleyland Study,* Borough of Etobicoke, Planning Department (Civic Centre, Etobicoke, Ont. M9C 2Y2), April 1978; and *Preservation of Ravine Lands,* Borough of York, Planning Board, (2700 Eglinton Ave., Toronto M6M 1V1), June 1978.

Case Study 36
Willows Save Streams

New York State has a program, now 40 years old and with a current budget of $250 000, that has successfully rehabilitated 200 of its 1 000 trout streams by planting willows along stream banks. When banks lack tree shade, water temperature increases to the point where it becomes difficult or impossible for trout to survive. Unprotected banks gradually wash away, greatly increasing the problem by making the stream wider, shallower, slower and warmer each year. In 1978 the State's Department of Environmental Conservation made available 152 800 rooted willows (they prefer the purple-osier and common pussy willow to larger trees such as the native black willow) and 30 000 one and two-year old silky dogwood shrubs for distribution to interested individuals and angling groups who

carry out the planting program in the spring and early summer. This approach – government supporting local groups who have an interest in and benefit directly from the program – is deliberate. The State feels the government cannot do it all.

Source: Mary Mastin, "Willows Save Streams in N.Y.", *Globe and Mail*, 19 July 1978.

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Information Resources

See also:
2.3 Water Quality, Water Quantity and Urban Runoff
2.4 Erosion
2.6 Wildlife and Fish

B.C. Ministry of the Environment, Resource Analysis Branch. *Aquatic Systems Inventory and Analysis.* The Branch (Parliament Buildings, Victoria V8V 1X4), 1977. 39 pp.

In British Columbia, stream systems are classified according to this interim report. Data are collected for fish species and for a variety of physical parameters of the stream, its floodplain and its valley.

Billington, C. and Toza, E.W. *Ecological Inventory of NCC Urban Corridors.* National Capital Commission, Interpretation Section (48 Rideau Street, Ottawa K1N 8K5), Aug. 1977. 101 pp.

These corridors of underdeveloped urban space, with unique environmental and recreational potential, include creeks and rivers. Annotated further in 3.6 Environmentally Sensitive Areas.

Canada – British Columbia Okanagan Basin Agreement. *Okanagan Basin Study.* B.C. Water Resources Service (Parliament Buildings, Victoria, B.C.), 1974.

A comprehensive framework plan was prepared consisting of a summary report, main report and technical supplements 1-X1.

Coughlin, Robert E. et al. *Stream Quality Preservation Through Planned Urban Development.* Philadelphia: Regional Science Research Institute, 1973. Paperback, 227 pp. Available from National Technical Information Service (5285 Port Royal Rd, Springfield, VA 22161), PB 222 177, $8.00.

This study attempted to determine the effect of urbanization on stream channel enlargement and to estimate, using a large sample of watersheds with varying types and degrees of urbanization, water quality effects typically produced by various types of urbanization. Although limited to giving a general indication of how these effects are produced, the study provides useful information on the relationship between urbanization and water quality. Key conclusions on the effect of urbanization on stream channel enlargement: (a) type of development is the most important consideration concerning stream flow and channel enlargement (the provision of sewerage appears to make much more of a difference than the location of development relative to the stream); and (b) the effect of a given amount of development on channel enlargement is greater for steeply sloped watersheds than for flatter ones. Key conclusions on the effect of urbanization on stream water quality: (a) during low flow conditions, urbanization has a significant effect for a number of chemicals often considered to be geologically determined rather than produced primarily by human activities (calcium, carbonate, magnesium, sodium, bicarbonate); (b) urbanization is likely to cause lower water quality regardless of what is done with sewage; and (c) generally, urbanization has a pervasive influence on water quality.

Dillon, M.M. Ltd., and MacLaren, James F. Ltd. *Flood Plain Criteria and Management Evaluation Study.* Toronto: Ontario Ministry of Natural Resources and Ontario Ministry of Housing, Dec. 1976. 104 pp. Available from Government of Ontario Bookstore (880 Bay Street, Toronto M7A 1N8), $4.00, cheque payable to Treasurer of Ontario. Ontario Ministry of Natural Resources. *A Discussion Paper on Flood Plain Management Alternatives in Ontario.* Aug. 1977. 19 pp. $1.00 from Government of Ontario Bookstore.

In the 20-year period 1950-70, 430 floods occurred in Ontario. Hurricane Hazel in 1954 caused $75 million damage and significant loss of life (in the past 70 years, 25 hurricanes have passed or come close to Ontario) and a recent flood on the Grand River resulted in over $7 million damage. Provincial floodplain policy aims at preventing loss of life and minimizing flood damage to existing and proposed floodplain development. Criteria for establishing floodplain objectives are frequently challenged, especially where land values are high. This report reviews present government policies and examines alternative design criteria for defining floodplains. Current criteria are regional storms based on Hurricane Hazel, Timmins storm and once-in-100-year flood; 6% of urban areas lie in the resulting floodplain which contains $750 million of existing development. More severe criteria would increase the land area designated as floodplain but reduce possible floodplain land damage; reducing the design flood criterion would increase the risk factor. A two-zone floodplain is proposed. All development would be prohibited in the central portion, the floodway, which carries the flood water; conditional development would be permitted in the remaining fringe zone of the floodplain. The Discussion Paper: summarizes the foregoing report and its technical papers; recommmends (among other things) giving municipalities increased scope to permit more intensive land uses in the fringe zone of their floodplains through adoption of the two-zone floodway-fringe concept (under certain conditions, and retaining the one-in-100-year flood or regional flood as design criteria); and invites public comment.

Dougal, Mervin D. *Flood Plain Management.* Ames, Iowa: Iowa State University, 1969. $6.95.

Environment Canada. *Monograph on Comprehensive River Basin Planning.* Environment Canada, Inland Waters Directorate (Ottawa K1A OH3), 1976. Paperback, 246 pp.

This treatise is concerned with the range of social, political and biological problems which arise in a river basin as its population and development increase. Chapters contributed by individual authors cover principles of planning for water management, the institutional background to basin planning, designing the planning process, establishing a reporting system, organizing and managing planning studies, information systems for river basin planning, public involvement, evaluation procedures, use of mathematical models, selection of recommendations, building bridges from planning to action programs, and financing. The Saint John River Basin is used as an illustrative example.

Horton, Robert E. *Erosional Development of Streams and Their Drainage Basins.* Geological Society of America (419 West 117th St., New York, NY), 1962.

Hynes, H.B.N. *The Ecology of Running Waters.* Toronto: University of Toronto Press, 1972. Hardcover, 555 pp. $27.50.

A basic text on streams and valleys by an international authority on the subject.

Layne, Elizabeth N. *The Natural Environment: A Dimension of Development.* National Audubon Society (950 Third Ave., New York, NY 10022), 1976. 32 pp. $1.00.

Chapter 1 of this brief but useful pamphlet deals with streams.

MacLennan Hugh. *Seven Rivers of Canada.* Toronto: Macmillan of Canada, 1975. Hardcover, $7.95.

Mann, Roy. *Rivers in the City.* New York: Praeger, 1973. Hardcover, $20.00.

Qu'Appelle Basin Study Board. *Report of the Qu'Appelle Basin Study Board.* Queen's Printer (Legislative Building, Regina, Sask.), 1972. 65 pp. $1.00.

Annotated in 5.4 Plans.

Québec Services de Protection de l'Environnement. *Liste des bassins de rivières et de lacs étudiés par le Service des relevés.* Services de Protection de l'Environnement, Gouvernement du Québec (914 rue Paradis, Ste-Foy, Qué. G1V 2T6), 1978. 8 pp.

Lists the main rivers in Quebec that have been surveyed by the agency. Surveys include the watershed of each river and deal with bacteriological, physico-chemical and biological quality of the river; pollution sources; and economic base of the region. Recommendations cover uses and quality-improvement of the river.

Shubenacadie-Stewiacke River Basin Board. *Interim Recommendations for Water Management in the Shubenacadie-Stewiacke River Basin.* Report and Interim Recommendations. The Board. (N.S. Dept. of the Environment, P.O. Box 2107, Halifax B3J 3B7). Dec. 1977. 32 pp.

Annotated in 5.4 Plans.

Southeastern Wisconsin Regional Planning Commission. *Floodland and Shoreland Development Guide.* SWRPC (Old Courthouse, Waukesha, Wisconsin 53180), 1968. 199 pp. Out of print; check with SWRPC Planning Library.

Annotated in 3.4 Marine Coastal Zone.

Tennant, Donald L. *Instream Flow Regimes for Fish, Wildlife, Recreation and Related Resources.* U.S. Fish and Wildlife Service (Billings, Montana), 1976.

Thurow, Charles, Toner, William and Erley, Duncan. *Performance Controls for Sensitive Lands: A Practical Guide for Local Administrators, Parts l and 2.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), P.A.S. No. 307 and 308, 1975. 150 pp. $12.00.

Discusses environmental protection and management approaches to streams and creeks, aquifers, wetlands, woodlands and hillsides with examples of U.S. municipal ordinances for erosion and runoff.

Tourbier, Joachim and Westmacott, Richard. *Water Resources Protection Measures in Land Development – A Handbook.* University of Delaware, Water Resources Center (42 East Delaware Ave., Newark, Del. 19711), 1974. 237 pp.

Annotated in 2.3 Water Quality.

University of Guelph, Centre for Resource Development. *Hanlon Creek Ecological Study.* City of Guelph, Dept. of Planning and Development (City Hall, 59 Carden Street, Guelph, Ont. N1H 3A1), Phase A, Sept. 1971, and Phase B, April 1972. 2 volumes.

This study was undertaken for the City of Guelph by a multidisciplinary team from Guelph University. Focused on Hanlon Creek's watershed south of the built-up area of Guelph, the study examined the biophysical characteristics of the watercourse system and recommend actions needed to minimize ecological impact of a proposed adjoining expressway. Phase A inventoried and analyzed soil and water resources, water quality, aquatic biology, terrestrial wildlife and vegetation. With reference to these resources it predicted the environmental impacts of the expressway as proposed and recommended drainage, vegetation, maintenance and monitoring measures to mitigate adverse impacts. Phase B went further to recommend planning and management measures for the watershed based on the principle that conditional urban development of the watershed could proceed and still preserve its essential environment resources. Recommendations cover soil systems, stream biology considerations (e.g., maintaining the trout stream), maintenance of terrestrial wildlife and vegetation, landscape quality control and social concerns. Alternative development policies for the watershed are presented (conservation vs. recreation vs. development). See also: E.E. Mackintosh, "The Hanlon Creek Study: An Ecological Approach to Planning", in Ralph R. Krueger and Bruce Mitchell (eds.), *Managing Canada's Renewable Resources* (Toronto: Methuen, 1977), paperback, 333 pp., $9.95.

U.S. Dept. of Agriculture. *Proceedings, River Recreation Management and Resource Symposium.* U.S.D.A., Forest Service (Washington, DC 20250), General Technical Report NC-28, 1977.

Van Groenewoud, H. *Interim Recommendation for the Use of Buffer Strips for the Protection of Small Streams in the Maritimes.* Environment Canada, Canadian Forestry Service (Ottawa K1A OH3), 1977. 18 pp.

The author, from the Maritimes Forest Research Centre in Fredericton, argues that properly designed buffer strips along small headwater streams can prevent, or at least reduce the deleterious environmental effects of logging (slash deposit in the stream, bank erosion, traffic across the stream, heating of the water through increased exposure, etc.). Such buffers can serve several purposes: protection against direct radiation and heating; protection from sediment emanating from the cut areas; protection from crossing by logging equipment; and a main source of food for animal life in the stream. The report proposes that on fairly level terrain a buffer strip l5-20 m wide, extending to the origin of the stream and including

springs, would be sufficient to protect the stream. Wider strips would be required on steeper terrain.

Warner, Maurice L. et al. *An Assessment Methodology for the Environmental Impact of Water Resource Projects.* Washington, DC: U.S. Environmental Protection Agency, Office of Research and Development, July 1974. Paperback, 221 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $3.00 plus 25% outside U.S.A.

Covers six topics: reservoir project planning, construction, and operations; water quality impacts of reservoir construction; ecological impacts of reservoir construction; economic, social and aesthetic impacts of reservoir construction; review criteria for assessing general statement completeness and accuracy; and a review of impact assessment methods. The water quality and ecological impact sections discuss the site-specific conditions under which a given potential impact may or may not occur. The section on water-quality impacts also presents a detailed comparison of mathematical models for predicting impacts on water temperature, dissolved oxygen levels, and some chemical constituents of surface waters.

Welch, D.M. *Land/Water Classification: A Review of Water Classifications and Proposals for Water Integration into Ecological Land Classification.* Ecol. Land Class. Series No. 5, Ottawa: Environment Canada, Lands Directorate, Sept. 1978. 54 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A OS9). $4.50 ($5.40 outside Canada).

Includes a discussion of classifications and inventories for lakes, rivers and shorelines.

Acknowledgements 3.2

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Phil Wood

3.2 Inland Wetlands

Inland wetlands comprise marshes, swamps, bogs, fens, sloughs, peatlands, prairie potholes – all areas where the land is poorly drained and completely or partly covered by freshwater for part of the year (saltwater wetlands are covered under 3.4 Marine Coastal Zone). Wetlands are rapidly disappearing under the onslaught of urbanization and agricultural drainage. Lack of monitoring makes it difficult to determine the scale and rate of the wetlands loss.

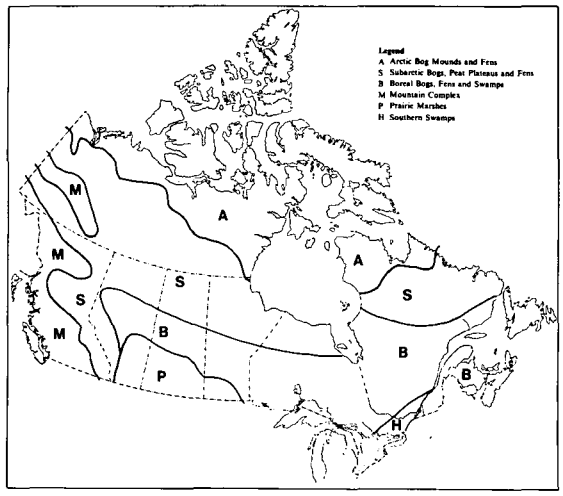
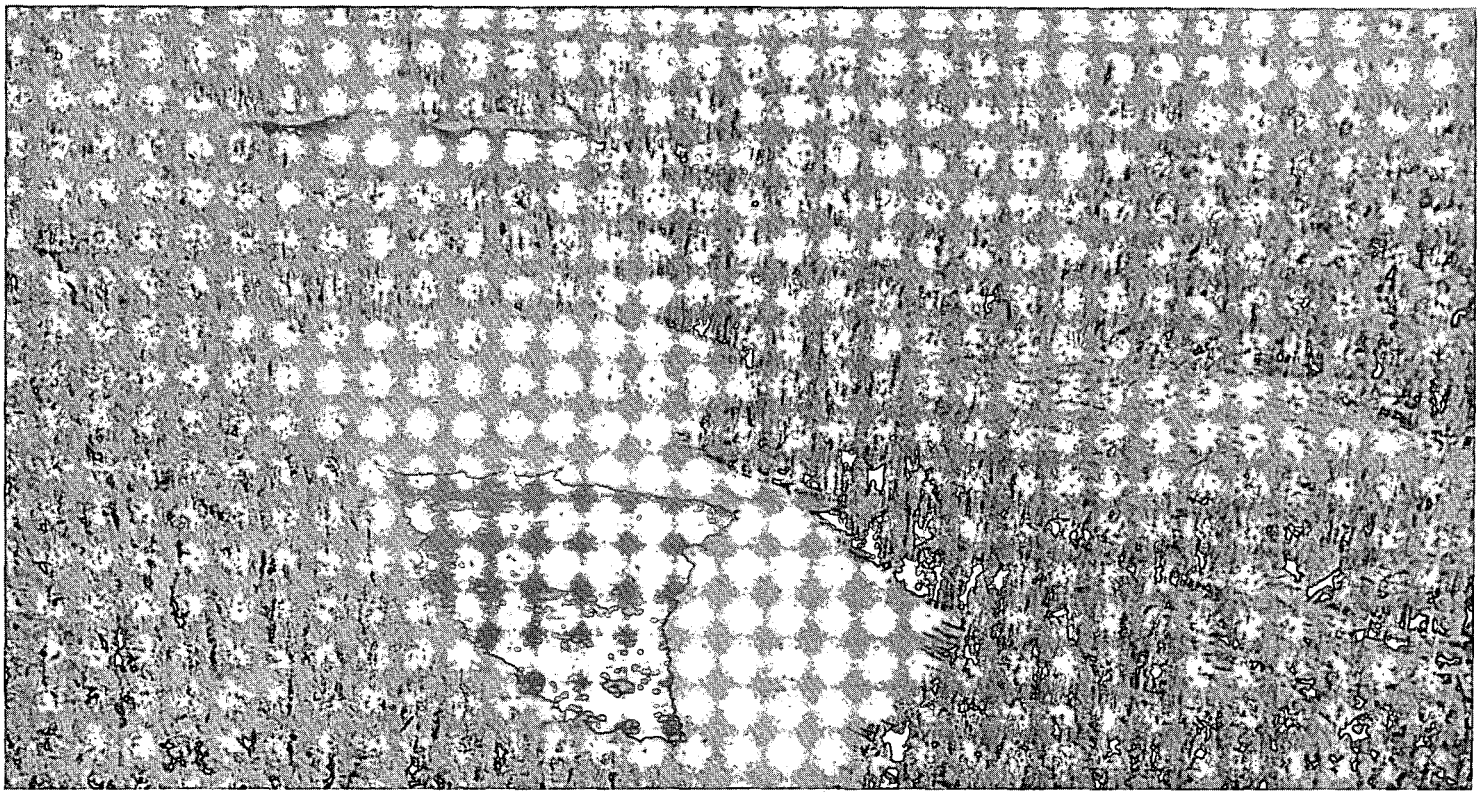


Figure 3.1 Wetland Regions of Canada

Adapted from: S.C. Zoltai, "Wetland Classification", in J. Thie and G. Ironside (eds.), *Ecological (Biophysical) Land Classification in Canada. Proceedings of the First Meeting, Canada Committee on Ecological (Biophysical) Land Classification, 25-28 May 1976, Petawawa, Ontario* (Ottawa: Environment Canada, Lands Directorate, 1976).

People often regard wetlands as unsightly mosquito-ridden areas, as a barriers to urban development, as land lost for agricultural production or as restrictions to recreational and cottage uses. This is the obvious and negatively perceived side of wetlands. They also perform numerous useful functions, most of which are not as readily apparent:

Water storage, groundwater replenishment and flow regulation. One acre of marsh is said to be capable of absorbing 300 000 gallons of water. Wetlands store water during wet periods, allowing time for it to recharge aquifers, and slowly release it in dry periods, which in turn prevents streams from running dry. Some settlements depend heavily on this function not only for water supply purposes but also as a barrier to flooding. Wetlands, by holding back waters that threaten urban areas or agricultural land, mitigate the impact of heavy storms.



Sediment control. Urban runoff contains substantial amounts of sediment especially near construction sites. As long as its absorptive capacity is not exceeded, a wetland can reduce stream sedimentation.

Filtration of pollutants. Wetlands can filter out pollutants as well as sediment. Some of them are oxidized and metabolized in the process of conversion to nutrients.

Wildlife habitat. Wetlands are areas of high biological productivity. They provide important shelter, breeding and feeding opportunities for many species of fish and birds, certain mammals such as moose and elk, and other wildlife. The waterfowl capability classification of the Canada Land Inventory is heavily influenced by wetland characteristics.

Recreation. Waterfowl rely on wetlands for resting and shelter during migration; as a result, hunting is the most popular form of recreation in wetlands. Fishing, bird-watching and hiking are other recreational uses. Although these do not attract many people to wetlands, most of us nevertheless enjoy seeing and hearing ducks, geese, frogs, and other forms of life which depend on existence of wetlands for their survival.

Microclimate modification. Reasonably sized wetlands, as bodies of standing water, will moderate temperatures somewhat.

Commercial value. Some wetlands yield commercial crops. Wild rice is an example.

Educational value. Wetlands are natural living museums, much in use by school teachers and others.

The problem in planning for wetlands is not what to do as much as how to accomplish it. Generally, leaving a wetland alone is sufficient to assure continued performance of its functions, provided that proper planning and controls are exercised on the areas that feed the wetland. Cost may not be the limiting factor since a municipality need incur no direct administrative, engineering or maintenance costs to maintain a marsh (there may be an opportunity cost in foregone tax revenue). Rather, the problem is that the functions performed by wetlands, seldom correctly assessed do not seem valuable; or when they are, serious equity problems arise (one group receiving the benefits, another bearing the costs). Compared to the benefits offered by a large residential or commercial

project, activities such as nature observation, hunting or water retention may appear insignificant. Yet a marsh does accommodate a great deal of water – three million gallons in a one-foot rise over 10 acres, according to Johnson. Removing such a wetland could mean a large increase in urban runoff and expensive public works measures to mitigate flooding. A case in Massachusetts (Layne, 1970) illustrates this point. Large wetlands, 100 to 2 340 acres in size, control flooding on the Charles River watershed. Cities in the heavily urbanized downstream area recently suffered millions of dollars of flood damage while the upper two-thirds of the watershed, thanks to the wetlands, escaped relatively unharmed. The U.S. Army Corps of Engineers has judged flood control by the wetlands to be more effective and less costly than an engineering solution.

Draining for agriculture or filling for urban development are the main threats to wetlands. Excessive siltation from urban runoff or nearby construction sites can inhibit water filtration and drive away desirable fish species. Pollution from fertilizers and runoff is also harmful. Excessive organic matter or nutrient-laden water can stimulate plant growth beyond the capability of a wetland to adjust. Whether through ignorance, carelessness or a desire to maximize benefits, closing off a wetland's outlet, overtaxing its capacity for absorption or exceeding its limitations in other ways, can limit its usefulness and eventually destroy it.

Case Study 37
Spawning Grounds of Ruisseau Saint-Jean: Research/Conservation/Management
Submitted by Michel Lagacé, Québec, Ministère du Tourisme, de la Chasse et de la Pêche

In 1972 a rich northern pike spawning ground was discovered in the Ruisseau Saint-Jean, located in the County of Châteauguay near Montréal. Proximity to Châteauguay's municipal drinking-water pumping station left this marshy area unaffected by development and relatively unchanged. However, part of the marsh, mostly on private property, is now slated for cottage development.

The marsh serves numerous functions. It has been used extensively for research and sampling as well as for reproduction of largemouth bass, pumpkinseed and brown bullhead and carp. Substantial diversity of aquatic riparian vegetation and the abundance of invertebrates makes the marsh a highly productive ecosystem. This habitat supports a diversity of wildlife including mammals, birds, reptiles and amphibians as well as many species of fish.

In an attempt to protect the marsh from adverse impacts of development, Québec's Ministère du Tourisme, de la Chasse et de la Pêche prepared a draft management plan. Emphasizing the importance of marshes as nurseries for biological resources and using the spawning grounds of the Ruisseau Saint-Jean as a typical case, the plan advances recommendations for the protection and restoration of marshy breeding areas and analyzes costs associated with implementation of the recommendations.

Refer to:
Y. Dubé, et Y. Gravel, *Plan pilote d'aménagement intégré des ressources biologiques du territoire de la frayère du ruisseau Saint-Jean, comté de Châteauguay, Québec*, Québec, Ministère du Tourisme, de la Chasse et de la Pêche, Direction de la recherche faunique, 1978, V + 52 pp. Free on request at the address below.

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Case Study 38
Wetlands Environmental Appraisal, Napanee River Basin Study
Submitted by A.R.V. Ribeiro, Crysler & Lathem Ltd.

A study of the Napanee River Basin, located at the eastern end of Lake Ontario, was undertaken during 1977 and early 1978 on behalf of the Napanee Region Conservation Authority. The study's objectives were: (a) to produce floodline mapping on a major portion of the Napanee River; (b) to assess the stability of eight dams on that River; and (c) to conduct an environmental appraisal of the Cameron Creek Swamp, an 8 200-acre wetland at the centre of this drainage system.

The Cameron Creek Swamp is the largest continuous area of swamp forest and wetland in the Napanee watershed. Suspecting that the area performed a significant hydrologic function in terms of flow modification in the downstream

Napanee River, and that the swamp contained sensitive ecological areas, the Authority requested that the consultant make provisions for its protection by placing a fill line around its perimeter. An integrated ecologic-hydrologic approach was employed by the consultants: first, to locate and determine the extent of ecologically sensitive areas, and second, to determine the hydrologic value of the swamp for peak-flow attenuation and water storage.

Ecological investigations determined that this wetland did not provide quality wildlife habitat due to extended periods of inundation. Waterfowl production, however, was substantial in some peripheral areas. The ecological elements of most interest were the vegetation associations and the deep organic deposits. A homogeneous, stable ash-elm-maple swamp forest covered almost 75% of the wetland and three rare species of trees as well as one species of sedge were observed. The tightly closed primary canopy reduced evaporation from the soil surface and contributed to the swamp's overall water-holding capacity. In addition, hydrologic investigations, which included computer modelling techniques, indicated that the organic soils played a significant role in modifying the flow regime of the Napanee River, in two ways. First, during periods of high precipitation the organic soils of the swamp stored approximately 5 300 acre-feet of water, thereby preventing flooding along the river. Second, at time of low precipitation, water is released from organic deposits into the river, providing up to 33% of total base flow. Based on the results of ecological and hydrologic investigations, criteria were developed to effectively locate a fill line which encompassed and protected areas of vegetative sensitivity as well as those performing a vital hydrologic function. Recommendations were made to the Authority regarding the incorporation of the Cameron Creek Swamp in the relevant official plan and restricted area (zoning) bylaw.

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Information Resources

See also:
3.4 Marine Coastal Zone
3.6 Environmentally Sensitive Areas

Federation of Ontario Naturalists. *How to Build a Marsh and Wetland Preservation: Your Responsibility.* FON (1202 Don Mills Road, Don Mills, Ont. M3B 2W7), n.d.

Two foldouts aimed at informing and stimulating people to action with respect to wetlands.

Goldstein, J.H. *Competition for Wetlands in the Midwest: An Economic Analysis.* Baltimore: Johns Hopkins Press, 1971. 105 pp.

A thorough study of the conflict between farmers, who suffer losses in production by tolerating wetlands on their properties, and hunters, who reap the benefits provided by the wetlands in harbouring migrating waterfowl. After empirical analysis the author concludes that the cost of draining wetlands in the Midwest would be prohibitive if farm prices were competitive, but with current price support policies, many wetlands can be economically drained. Possible ways to avoid this without removing the price supports are to prohibit drainage without a permit; obtain easements on wetlands using general government revenue; pay farmers not to drain them; and finance it through a tax on duck hunters. The equity problems here, as in so many environmental conflicts, are difficult to resolve.

Hartland-Rowe, R. *Used Swampland as a Natural Sink for Receipt of Sewage Effluent.* Indian and Northern Affairs Canada (Ottawa K1A OH4), Environmental-Social Program, Northern Pipelines Report No. 73-15, 1973.

Irwin, Harriet A. *A Natural History Study of East Marsh of The University of Wisconsin Arboretum.* University of Wisconsin, Department of Botany (430 Lincoln Drive, Madison, WI), 1973.

M.Sc. thesis comprising in-depth studies of wetland hydrology and management.

Jeglum, J.K. et al. *Toward a Wetland Classification for Ontario.* Environment Canada, Forestry Service (Ottawa K1A OH3), Information Report No. 0-X-215, 1974.

Johnson, P.L. *Wetland Preservation.* New York: Open Space Institute (145 East 52nd Street, New York, NY 10022), 1969. 85 pp.

Catalogues the values of wetlands and openly advocates their preservation. Preservation methods and legal regulation are discussed and a suggested model local law is presented. The lengthy appendix describes a variety of protective devices used by states and municipalities in the United States. Concentrates on tidal marshes but can be applied equally to inland wetlands.

Lang, Reg and Armour, Audrey. *Municipal Planning and the Natural Environment.* Toronto: Ontario Planning Act Review Committee, Sept. 1976 (published 1977). Paperback, 90 pp. Available from Government of Ontario Bookstore (880 Bay Street, Toronto M7A 1N8), $1.25, cheque payable to Treasurer of Ontario.

In the listing of municipal environment concerns in Ontario (pp. 3-7) water resources management was found to be No. 1. Wetlands are one of the specific areas of concern related to water resources. Respondents to the survey mentioned disruption of marshland sanctuaries, pollution, and filling or drainage, all of which affect the life-support systems of creeks and streams. Annotated further in 1.3 Characteristics of Environmental Planning.

Layne, E.N. *The Natural Environment: A Dimension of Development.* New York: National Audubon Society (950 Third Avenue, New York, NY 10022), 1976, 32 pp. $1.00.

Chapter 3 (pp. 14-17) is on inland wetlands.

Luken, R.A. *Preservation Versus Development: An Economic Analysis of San Francisco Bay Wetlands.* New York: Praeger, 1976. Hardcover, 155 pp. $16.50.

A technical analysis of the economic efficiency of a complete prohibition (compared with complete permission) on unjustifiable filling of the Bay Area wetlands. "Unjustifiable filling" means those reclamation activities that would sustain non-water-related industrial, commercial or industrial activities. The study compares preservation values with development values. Preservation value is the imputed dollar value of activities that would have occurred on wetlands minus the value of those activities at an alternative location; it does not include ecological functions performed by the wetlands. The study nevertheless concurs with the State's prohibition of unjustifiable filling. It predicts development pressures on the wetlands to 1990 by means of urban growth models.

Millar, John B. *Wetland Classification in Western Canada.* Environment Canada, Wildlife Service (Ottawa K1A OH3), 1976. 38 pp. $2.00.

Suggests a nomenclature for classifying wetlands and then discusses how to implement it. The paper lists the vegetation found in wetlands and defines wetland types according to the vegetation zone occupying the centre of the depression (with one exception). Vegetation indicates the wetland's salinity and its history of disturbance. Ways of classifying wetlands by their physical features are discussed. Other classification systems in common use are mentioned.

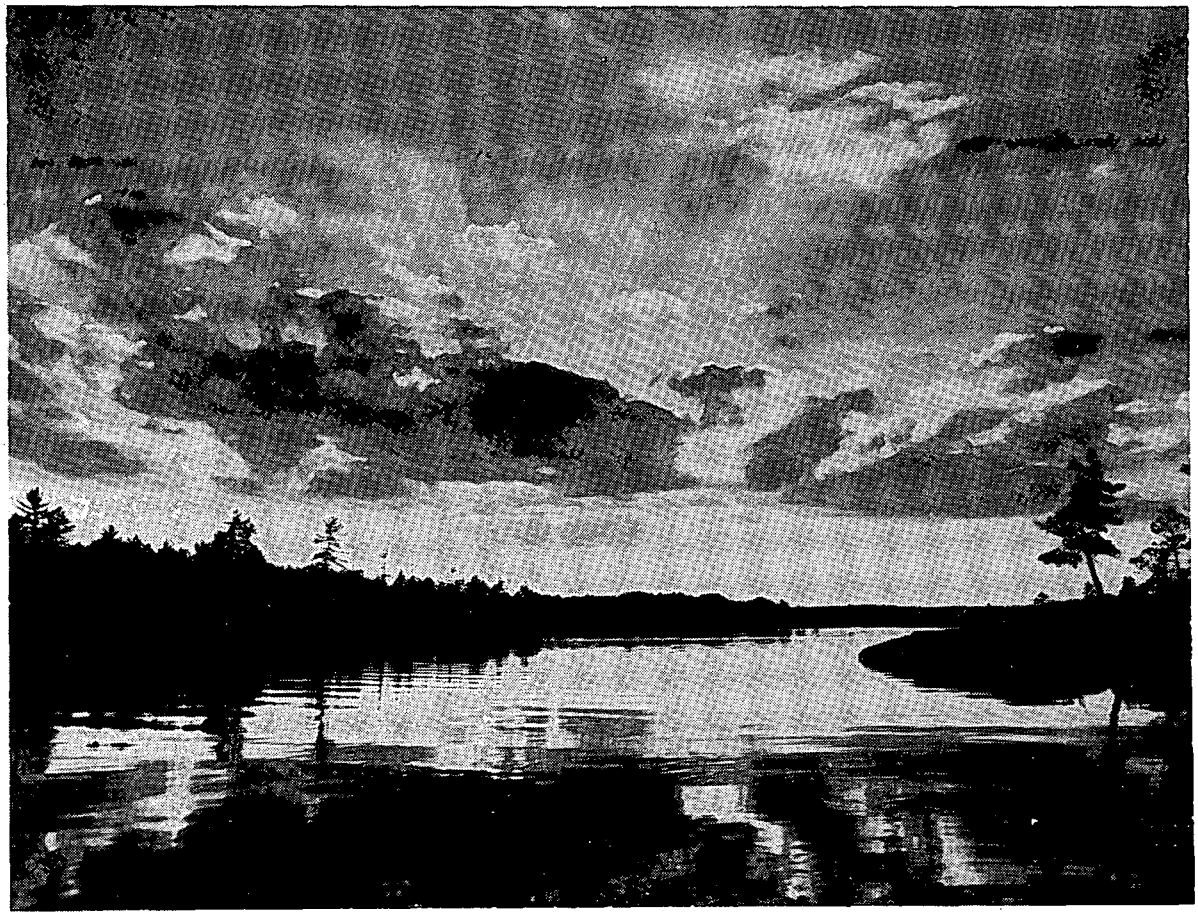
3.3 Lakes

Canada has a larger lake area than any other country. Excluding small ponds, non-permanent lakes, marshes, and wet tundra, the Canadian freshwater area measures over 750 000 square kilometres. More than one quarter of the world's fresh water is stored in our lakes. They are unevenly distributed across the country, however, which affects their value as a resource in any particular setting and the planning/management approaches considered appropriate.

Lakes, ranging in size from ponds to large water bodies covering thousands of square kilometres, perform many valuable functions. They provide water for drinking, industrial use and irrigation. As a recreational resource they accommodate a variety of uses such as cottages, boating, swimming and fishing. They provide a stable environment for a wide range of species and they offer a staple food supply. Although lakes can be grouped into classes with similar characteristics, practically all lakes can be considered unique since a large number of factors and their complex interactions determine their characteristics.

Five factors generally shape lake environments:

1. Geologic formations underlying a lake basin will determine the amount and kinds of minerals and sediments entering a lake and its productivity. In the Precambrian Shield, for example, geological substrates are relatively insoluble; lakes in this area usually have a low mineral content.
2. The size and shape of the drainage system affect the amount of minerals and sediments that are eroded from geologic formations. The longer the run of water, the more materials are likely to be eroded over time.
3. The shape of a lake basin (the amount of shoreline and depth of the lake) affects almost every aspect of its biology. In a lake there are two zones of photosynthetic activity – the littoral (shallow-water) zone where light penetrates to the bottom, and the limnetic (open-water) zone which extends to the depth of effective light penetration. Broad shallow lakes with a long shoreline are more productive than deep lakes with steep sides.



Sather, J.H. (ed.). *Proceedings of the National Wetland Classification and Inventory Workshop, College Park, Maryland.* U.S. Dept. of the Interior (Washington, DC 20240), 1975.

Thurow, Charles, Toner, William and Erley, Duncan. *Performance Controls for Sensitive Lands: A Practical Guide for Local Administrators, Parts I and 2.* American Society of Planning Officials (1313 East Sixtieth Street, Chicago, IL 60637), P.A.S. No. 307 and 308, 1975. 156 pp. $12.00.

Discusses environmental protection and management approaches to streams and creeks, aquifers, wetlands, woodlands and hillsides with several examples given of U.S. municipal ordinances for erosion and runoff.

Zoltai, S.C. et al, "Developing a Wetland Classification for Canada", in B. Bernier and C.H. Wingo (eds.). *Proceedings, 4th North American Forestry Soils Conference.* Les Presses de l'Université Laval, 1973, pp. 497-511.

A hierarchical classification system is provided, with four levels of detail determined by the following criteria: Level 1 – Physiognomy of the wetlands; Level 2 – surface morphology; Level 3 – vegetation; and Level 4 – needs of particular disciplines. The aim is to facilitate meaningful communication among wetland users and to enable more precise definition of wetland types within climatically determined regions. See also: S.C. Zoltai, "Wetland Classification", CCELC, J. Thie and G. Ironside (eds.), *Ecological (Biophysical) Land Classification in Canada. Proceedings of the First Meeting, Canada Committee on Ecological (Biophysical) Land Classification, 25-28 May 1976, Petawawa, Ontario,* Ecol. Land Class. Series No. 1, Environment Canada, Lands Directorate (Ottawa K1A OE7), 1976.

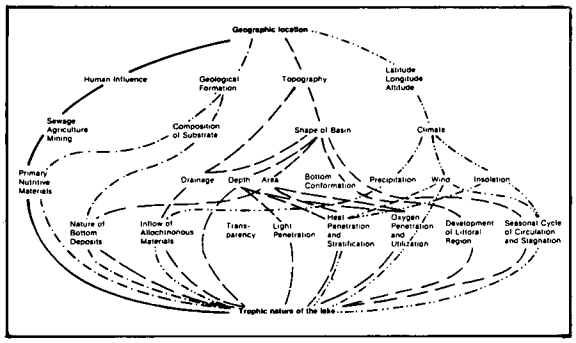


Figure 3.2 Factors Determining the Trophic Nature of Lakes

Source: adapted from P.A. Larkin, *Freshwater Pollution, Canadian Style* (Montreal: McGill-Queen's University Press, 1974)

4. Wind has a major effect on lake production. Oxygen and thermal stratification, circulation of nutrients essential to plant growth, and distribution of organisms are determined to a large extent by the force of winds available to recirculate lake waters. In a shallow lake strong winds help to mix the water in spring and autumn, "overturning" it from top to bottom. In a deep lake the force of winds is insufficient to stir up the waters to any degree.
5. Human activity can have a heavy and pervasive impact on lake quality. Pollution and eutrophication are two significant problems. Lakes receive large quantities of industrial wastes, sewage and silt from recreational agricultural and urban areas. The ill effects of pollution are not limited to the contamination of water, fish and wildlife; pollution also hastens the degeneration and eventual extinction of lakes as life-sustaining bodies of water. Natural eutrophication (see Case Study 39) or aging of lakes is generally a very slow process, its rate determined by the physical, chemical and biological characteristics of the lake and its watershed. Cultural eutrophication occurs at a much faster rate and is directly related to increases in nutrient loading from human sewage, detergents and artificial fertilizers. Increasing the rate of eutrophication can lead to deterioration in water quality and loss of recreational value. The proliferation of permanent homes, cottages and marinas along lake shorelands add to eutrophication from urban, agricultural and industrial activities. Lake developments can result in such effects as clearing of shoreline vegetation, dredging of the littoral zone, nutrient loading from septic systems and garbage dumps and oil pollution from motor boats.

Minimizing man's impact on lakes is a difficult social, political and scientific problem. For example, the International Joint Commission, a quasi-judicial organization which has been overseeing joint environmental activities of Canada and the U.S.A., states in its latest annual report that progress towards the goals of the 1972 Canada-U.S. Great Lakes Water Quality Agreement "continues to be slow and uneven"; as a result of large expenditures on remedial measures "the continued degradation of the lakes has been substantially checked" but there remains concern with "the growing evidence of the danger of toxic chemicals in the lakes" and the failure by authorities "to implement enforcement measures on industrial and municipal sources of pollution".

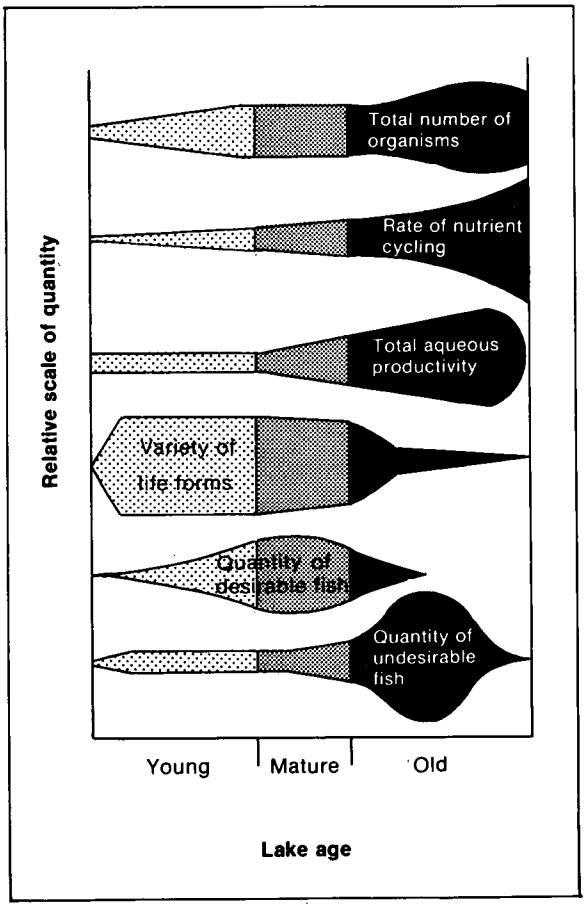


Figure 3.3 Indicators of Aging in a Lake

Source: G. Tyler Miller, Jr., *Living in the Environment: Concepts, Problems and Alternatives* (Belmont, CA: Wadsworth Publishing Co., 1975). Reproduced with permission.

Acknowledgements 3.3

This section includes contributions from:

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Ken Redpath
Ross Thomasson
Beverley Hanna Thorpe
John Underwood
Alan Vaughan
Ian Wight

Table 3.1 Land Uses and Potential Contaminants of the Great Lakes

Land Use Category	Activity	Main Contaminants
Urban	Residential, commercial and industrial construction site runoff Stormwater runoff	Sediment, chemicals, nutrients, pesticides
Agriculture	Application of pesticides, fertilizers Feedlot operations, animal wastes Erosion from general farm practices Drainage	Sediment, nutrients, chemicals
Liquid, Solid and Deepwell Waste Disposal	Solid wastes from residential, industrial, institutional sources Liquid sewage sludge Private sewage disposal systems Liquid industrial waste	Leachates from disposal sites, and chemicals
Shoreline Landfill	Land or construction excavation Dredging	Sediment and chemicals
Transportation	Runoff from construction, use and maintenance of highways, roads, railroads, airports, pipelines, utility rights-of-way	Sediment and chemicals
Extractive Operations	Pits and quarries Mining Brines, from oil and gas operations, requiring disposal	Sediment and chemicals
Forestry	Timber production including cutting operations and construction, maintenance and use of roads Woodland grazing Wildlife management Recreation including construction, maintenance and/or protection of recreation sites, forest roads and trails	Sediment, nutrients and pesticides
Recreation	Hiking Skiing Snowmobiling Riding All-terrain vehicle use Private waste disposal systems associated with vacation homes	Sediment, nutrients and chemicals

Source: J.F. Castrilli, *Control of Water Pollution from Land Use Activities in the Canadian Great Lakes Basin: An Evaluation of Legislative, Regulatory and Administrative Programs* (Windsor, Ont.: International Joint Commission, 1977).

We rely on lakes for many purposes. Yet we know far too little about either the complex processes shaping the lake environment or the measures necessary to manage lake resources effectively. The commitment to gain the necessary knowledge and take the required management actions is generally inadequate.

Case Study 39
Eutrophication

Lakes normally undergo an aging process, displaying different characteristics as they proceed through ecological succession from young to old. The productivity (amount of life) of a lake depends on its supply of nutrients, namely, phosphorous, carbon and nitrogen. *Eutrophication*, from the Greek "well nourished", is the process of enrichment with nutrients. A lake with a large or excessive supply of nutrients is called a *eutrophic lake* while one with a low supply of nutrients is termed *oligotrophic*. Eutrophication is sometimes confused with the succession process which depends on nutrient enrichment and many other variables. Whether eutrophication is deemed good or bad has to do with the age of the lake, the degree of eutrophication and the uses desired of the lake.

The sources of nutrients supply to a lake depend on the organisms present, bottom sediments, drainage from its watershed and atmospheric inputs. *Natural eutrophication* refers to nutrient enrichment resulting from natural changes such as forest fires. *Cultural eutrophication*, on the other hand, refers to the results of human activities (fertilization, silt, sewage, animal waste, detergents, erosion, runoff, de-icing salt, etc.) which can greatly increase the degree of nutrient runoff and enrichment.

Case Study 40
Lakeshore Capacity Study, Ontario
Submitted by Jean Downing, Ontario Ministry of Housing

Community planners in Ontario for many years have had difficulty evaluating subdivision proposals which involve cottage development on

the shores of inland lakes. In response to this need the Lakeshore Capacity Study was initiated by the Community Planning Branch of the former Ontario Department of Municipal Affairs. Based on the carrying capacity concept, the Study is developing methods to predict the impact of cottage development on selected aspects of the environment with emphasis on water quality, fisheries, wildlife and public health, in relation to existing lakeshore development. Three provincial ministries are involved in the study: Housing (responsible for administration of The Planning Act) which is managing the work and doing research on lakeshore land use; Environment, which is examining the effects of lakeshore development on water quality and on the risk of infection due to body contact with water such as in swimming; and Natural Resources, which is investigating fisheries and wildlife productivity in relation to lakeshore development levels.

Study findings are expected to assist decision-makers in three ways. First, by providing capability to determine the carrying capacity of a lake and the probable impact of a specific development proposal, the findings will make it feasible to use the available capacity more fully. Second, by providing the capability to identify the effects of various alternatives, the findings will permit decision-makers to make better informed choices and tradeoffs. Third, by providing methods to predict carrying capacity and the environmental sensitivity of an individual lake, the findings will provide valuable information input to regional official plans (lakeshore development can be related to the physical resources and vulnerability of each lake in a region), local official plans and more specific development planning within these frameworks. Although the Study focuses on Muskoka and Haliburton which lie within the Precambrian Shield, methods developed in this study area should be capable of adaptation to other physiographic regions in Ontario and elsewhere.

Environmental research requires the examination of existing conditions over several summer seasons since conditions differ from year to year. The Lakeshore Capacity Study, scheduled for completion in 1981, is now near its mid-point.

Refer to:
Ontario Ministries of Environment, Housing and Natural Resources, *Lakeshore Capacity Study, Progress Report*, Ontario Ministry of Housing, Local Planning Policy Branch (56 Wellesley St. W., Toronto M7A 2K4), Feb. 1978, 118 pp.
Free (supply limited).

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Case Study 4l
Lake Carrying Capacity, Northern Saskatchewan
Submitted by Reiner Jaakson, University of Toronto

Emma and Christopher Lakes comprise four eutrophic water bodies located about 50 km north of Prince Albert. Extensive recreational development exists around the lakes (1 800 cottages, a number of trailer courts and rental cabins, and a provincial campground) with a peak-season recreation population of 10-15 000. The Provincial Department of the Environment commissioned a study to: (a) examine alternative future plans for the lakes and determine if more development could be accommodated; and (b) devise a new method of measuring the carrying capacity of lakes for recreation.

The study comprised: a comprehensive *resource inventory* of the area, with public participation, including mapping and evaluation of the capability of land and water to sustain different uses; development of a "*spectrum model*" to determine lake carrying capacity for recreational uses; deriving *concept plans* for the four lakes; and refining of these plans to produce *management alternatives*, again with public participation. The spectrum model involved four calculations – natural shoreline reserve calculation, shoreline capability calculation, theoretical boat-limit calculation, and observed boat-density calculation. The mean value and range for each calculation were shown schematically for each lake enabling its carrying capacity situation to be seen at a glance. Instead of a single estimate as the basis for lake planning (as is done in the boat-limit and LAKEALERT approaches) the spectrum model provides a range of capacity estimates that allow consideration of a series of alternative lake plans. Concept plans for the four lakes were derived from an integration of the results of the carrying capacity calcu-

lations and resource inventory. Four concepts were presented: increased use, stabilized use (the public's first choice), constrained use (second choice) and decreased use. Concept plans were further refined so that management alternatives could be developed in detail; the intent was not to develop a master plan for the lakes but rather to recommend to the government what to consider when various departments establish their detailed plans for the area. To this end, a 96-cell matrix was developed displaying the relationships between (a) the four plan concepts, and (b) six generalized land uses on each lake (private recreation, commercial recreation, public recreation, transportation, nature conservation, and resource extraction). One lake at a time was ranked on each concept in relation to a given land use. Ranking in the matrix provided a necessary mechanism for relating carrying capacity to resource characteristics and capability.

The method shows an advance over earlier single-estimate approaches. Its use for other lakes, however, should be preceded by analysis of the specific ecological/environmental/recreation/social-activity conditions at the site in question with subsequent modifying of the spectrum model to the site.

Refer to:
Reiner Jaakson, et al., "Carrying Capacity and Lake Recreation Planning: A Case Study from North-Central Saskatchewan, Canada", *Town Planning Review,* Vol. 47, No. 4, Oct. 1976, pp. 359-373. Also: Reiner Jaakson, "Recreational Zoning and Lake Planning", Town Planning Review, Vol. 43, No. 1, Jan. 1972.

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Case Study 42
Lake Inventories and Management Plans, Red Deer Region

Substantially increased use of its lakes for recreation combined with concern over the unprecedented impacts of human activities on them prompted the Red Deer Regional Planning Commission to undertake a major program aimed at planning and managing the region's lake and shoreland resources as an integrated system.

Central to the program is a Regional Lake Inventory which puts lakes into a regional perspective: first, so that the full diverse value of these resources can be understood, and second, to emphasize the need for a similar provincial perspective. The report on the inventory (noted below) provides management principles for lakes based on a regional lake classification system. Individual lake management reports follow; three are referenced below. They: provide an essential understanding of each lake's resources, uses and problems; state the regional lake philosophy ("lakes are a public resource and consequently they should be planned and managed for the total public good as part of a regional open space recreation area system, but this system must reflect the need for conservation, economics and private demands where compatible with the total public good, now and in the future"); set out the lake's development potential based on a carrying capacity method; and present a management plan for the lake and its shoreline (land use, water use, transportation, and environmental protection, no site detail) including control measures.

Lake management plans are conceptual only and they are not officially binding on the municipalities, as is usual with Municipal General Plans under The Planning Act. The lake plans, however, are approved in principle by the municipalities concerned. They amend their bylaws accordingly, which means they agree with the objectives (based on experience so far) and make their development control and other relevant decisions affecting each lake on the basis of its plan. The Commission is now pursuing a similar program for one of its river valleys.

Refer to the following documents, published by and available from the Red Deer Regional Planning Commission: *Regional Lake Perspective: Inventory and Policy Directions,* May 1976; *Pine Lake Management Plan,* Feb. 1977; *Buffalo Lake Management Plan,* Feb. 1977; and *Sylvan Lake Management Plan,* Feb. 1977.

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Information Resources

See also:
2.3 Water Quality, Water Quantity and Urban Runoff
3.1 Streams and Valleys
3.2 Inland Wetlands
3.4 Marine Coastal Zone

Ableson, D.H.G. *Proposed Guidelines for Control of Recreational Development of Lakeshore Property.* B.C. Ministry of the Environment, Pollution Control Branch (1600 Third Ave., Prince George, B.C. V2L 3G6), March 1978. 38 pp.

Prepared for the Lakeshore Management Committee, these guidelines are aimed at preserving and enhancing water quality in recreational lakes while simultaneously providing management policies consistent with existing and future uses. The importance of water quality is closely linked to the recreational demands on the lakes.

Beaulieu, Andree and Lee, T.R. *Great Lakes Water Use Map.* Dept. of Energy, Mines and Resources, Canada Map Office (615 Booth St., Ottawa K1A OE9), Map JN 359, 1971. $1.00.

A colourful wall map that presents the variety of pressures on the Great Lakes on both the Canadian and American sides. Includes population density, irrigation, power development, commercial fishing, water withdrawal and waste discharge.

Davenport, S. (ed.). *Issues Related to Interfacing Water Resource Planning and Land Use Planning: Development and Application of Quantitative Procedures.* INTASA (1120 Crane Street, Menlo Park, CA 94025), May 1976. Paperback, 186 pp. + Appendices.

Final report of a two-year research project which focused on developing and testing methods to integrate land use and water resource planning. The report describes the results of three problem areas examined in detail: the issues of establishing regional planning priorities; methods of determining the costs associated with land use projects; and information exchange between land use and water planning.

Dickman, M. *A Documentation for the NCC of Some Factors Allowing the Eutrophication of Pink Lake Quebec, Including a Special Report on Lakeside Erosion During 1974.* Ottawa: Calanus Ecological Consultants Ltd., 1974, 134 pp. National Capital Commission. *Gatineau Park Conceptual Plan and Technical Addendum in Methodology, Inventory, Analysis.* NCC (48 Rideau St., Ottawa K1N 8K5), 1976. 77 pp. French and English versions.

A nutrient budget was carried out to determine the source of nutrients entering Pink Lake. Two main factors were identified: heavy pedestrian use which causes erosion of phosphate-rich apatite rock into the lake; and beaver ponds which drain slowly into the lake during the summer. Beavers were removed and the Gatineau Park Conceptual Plan has recommended closing the lake. Monitoring is in progress. For further information contact Stewart Hamill, NCC, or Dr. Mike Dickman, Dept. of Biology, Brock University, St. Catharines, Ont. L2S 3A1.

Dillman, P.J. and Rigler, F.H. "A Simple Method for Predicting the Capacities of a Lake for Development Based on Lake Trophic Status", *Journal of Fisheries Research Board of Canada,* Vol. 32, 1975, pp. 1519-1531.

Annotated in 2.3 Water Quality and elaborated in Dillon, P.J. *A Manual for Calculating the Capacity of a Lake for Development,* Ontario Ministry of the Environment, Water Resources Branch Limnology, and Toxicity Section (Resources Road, Rexdale, Ont.), 1974.

Dillon, P.J. et al. *Acidic Precipitation in South-Central Ontario: Recent Observations.* Ontario Ministry of the Environment (Box 13, Rexdale, Ont.), Sept. 1977. 24 pp.

Described as Case Study 6 in 2.2 Air Quality.

Dunst, R.C. et al. *Survey of Lake Rehabilitation Techniques and Experiences.* Wisconsin Department of Natural Resources (Madison, WI), Technical Bulletin 75, 1974.

Reviews at least 17 techniques ranging from lake bottom sealing to biological controls. References numerous studies around the world where these techniques are being used.

Flatt, Paul E et al., "Assessment of Environmental Impact on the Aquatic Environment with Limited Field Data", in American Society of Civil Engineers. *Proceedings of the Specialty Conference on Environmental Impact of Irrigation and Drainage, Ottawa, July 21-23, 1976.* ASCE (345 E. 47th St., New York, NY 10017), 1976.

Great Lakes Basin Commission. *Great Lakes Basin Framework Study.* Great Lakes Basin Commission (P.O. Box 999, Ann Arbor, MI 48106), 1977. 16 pp.

A booklet describing the 27-volume study.

Hansen, William A. and Bigelow, F. *Lake Management Case Study: West Lake Village, California.* Urban Land Institute (1200 18th Street NW, Washington, DC 20036), 1977.

Henderson, H.F. et al., "Assessing Fishery Potentials of Lakes and Reservoirs", *Journal of Fisheries Research Board,* Vol. 30, 1973, pp. 2000-2009.

Hough, Stansbury & Associates Ltd. *Water Quality and Recreational Use of Inland Lakes.* Ontario Ministry of the Environment, Southeastern Region (133 Dalton St., P.O. Box 820, Kingston, Ont. K7L 4X6), May 1977.

Review of the water quality program of the Ministry's southeast region, aimed at acquainting the public with the program's findings. Outlines the nature of limnological problems affecting recreational lakes.

Annotated in 2.3 Water Quality. See also, in that section: International Reference Group on Great Lakes Pollution from Land Use Activities, *Environmental Management Strategy for the Great Lakes System,* IJC, 1978; and J.F. Castrilli and A.J. Dines, *Control of Water Pollution from Land Use Activities in the Great Lakes Basin,* IJC, 1978.

International Joint Commission. *Annual Report, Great Lakes Water Quality.* IJC (100 Ouelette Ave., Windsor, Ont. N9A 673). Published annually.

Jaakson, Reiner, "Riparian Land Management in Saskatchewan and Ontario", in Krueger, Ralph R. and Mitchell, Bruce (eds.). *Managing Canada's Renewable Resources.* Toronto: Methuen, 1977. Paperback, 333 pp. $9.95.

Discusses the planning and management of lake and reservoir shorelines and other riparian interfaces including case studies of the South Saskatchewan River Project (Lake Diefenbaker) and the Trent Canal storage reservoir-lake in the Haliburton Highlands region of Ontario. The last part of the paper sets out a series of general proposals for improving shoreline land use planning and management. The author concludes:

Riparian land management forms a unique variation of the broad field of land-use planning. To effectively interrelate the land and the water environments, riparian land management necessitates specialized techniques in addition to the general principles commonly associated with land-use planning. Shorelines must be planned and managed as one continuous biophysical system; treating the land and the water as independent units is both erroneous and futile. New land management tools must be established if riparian areas are to be planned and used effectively. The tools must reflect the role of riparian land as part of an ecotone of overlapping shoreline ecosystems that are vulnerable to environmental deterioration, particularly to intensive development beyond natural carrying-capacity levels. Furthermore, riparian use must be safe and it must safeguard the right of the general public to use water and its associated land areas.

Larkin, P.A. *Freshwater Pollution, Canadian Style.* Montreal: McGill-Queen's University Press, 1974. Paperback, 132 pp. $2.95.

Miller, G. Tyler, Jr. *Living in the Environment: Concepts, Problems and Alternatives.* Belmont, CA: Wadsworth Publishing Co., 1975. Hardcover, 593 pp. $16.45.

See "Eutrophication and Agricultural Water Pollution", pp. E109-119.

Milton Keynes Development Corporation. *Balancing Lakes.* Milton Keynes Development Corporation (Milton Keynes, Bradwell Abbey Field Centre, Abbey Road, Bradwell, Milton Keynes, England), April 1974. 48 pp.

Discusses the biological implications of attempting to create a balanced (stable) biological situation in used surrounding the water. Problems and management approaches are discussed.

Ontario Ministry of the Environment. *Facts About Cottage Pollution Control.* MoE (135 St. Clair Ave. W,, Toronto M4Y 1P5), 1978. 9 pp. Free.

Aimed at citizens who own cottages on lakes, this brief straightforward paper discusses eutrophication and lake processes, aquatic plant control, plant harvesting, the A.I.D. method to aerate

lakes low in oxygen, septic tank installations and controls, microbiology of water, the rainfall effect on bacteria, water treatment, boating and marine regulations, and blackflies and mosquitoes.

Ontario Ministry of Natural Resources. *Lake Planning.* The Ministry (99 Wellesley St. W., Toronto M7A 1W3), 1975.

Peace River Regional Planning Commission. *Sturgeon Lake Management Plan: First Draft.* Feb. 1978. 67 pp. Gladish, M. et al. *Sturgeon Lake Planning Study: Technical Paper No. 2, Development Capacity Estimates.* PRRPC, Nov. 1975. Wight, I. and Mack, C. *Sturgeon Lake Planning Study: Interim and Progress Report.* PRRPC, 1975. The Commission (10104-101 Ave., Peace Building, Grande Prairie, Alta T8V OY3)

These reports document an approach to the planning and management of a significant lake, in the Peace River Region, coming under pressure for recreational and tourist development. Carrying capacity estimates based on four techniques (boating use, shoreland capacity, water quality index and Dillon-Rigler phosphorous concentration) did not seem entirely suitable, indicating the existence of over and under-development. (Political and public response to the ambiguous results favoured restricting development to protect environmental quality.) The fact that these techniques were based on other conditions (Southern Ontario) suggests a need to develop data for a technique unique to Peace River conditions. For further information contact Ian Wight, Senior Regional Planner, Peace River Regional Planning Commission, phone number (403) 532-0988.

Petite Rivière Watershed Advisory Group. *Proposed Revised Regulations for Minamkeak Lake Protected Water Area.* Lunenburg County District Planning Commission (P.O. Box 341, Bridgewater, N.S. B4V 2W9), 1976.

The Group, comprising local councillors and a representative of a cottage owners' association, was created by the N.S. Minister of the Environment to offer advice on a variety of issues in the drainage area of the Petite Rivière in rural southwestern Nova Scotia. This report proposes new regulations, replacing those felt to be inadequate, for all lake-oriented development activity, to be administered by the Public Service Commission of the Town of Bridgewater. The regulations are intended to be straightforward and easily comprehended by the people they will affect. A matrix relates uses/activities (e.g., car washing, swimming) to concerns (e.g., pollution, erosion) while another displays use/ activity vs. regulations.

Powers, Charles F. and Robertson, Andrew, "The Aging Great Lakes", in Scientific American Inc. *Man and Ecosphere.* San Fransisco: W.H. Freeman and Co., 1971.

Québec Ministére des Terres et Forêts. *L'Aménagement des berges de lacs.* Ministére des Terres et Forêts (2700 Einstein, Ste-Foy, Qué. G1P 3W8), Nov. 1977.

Discusses lake ecosystems, presenting some principles of the planning of lakeshores.

Québec Services de Protection de l'Environnement. *Les programmes des lacs et Liste des lacs en attente.* Services de Protection de l'Environnement, Le programme des lacs (201, Crémazie Est, Montréal, Qué.), Jan. 1978.

The first publication directed toward cottage associations explains Quebec's lake program aimed at preventing pollution (especially by septic tanks) and other forms of environmental degradation, and at protecting lakes on which there is cottage development. The second publication lists a number of lakes that have been and will be surveyed under the program (classification of septic tank installations, existing development, vegetation, limnology, water regime, wildlife, etc.). During the past five years more than 175 lakes have been surveyed; about 30 more will be done in 1978.

Tourbier, Joachim and Westmacott, Richard. *Lakes and Ponds.* Urban Land Institute (1200 18th St. NW, Washington, DC 20036), 1976. 70 pp.

Discussion on the use of lakes and ponds, particularly man-made, in urban developments. Includes design criteria, problems and benefits, and legal and management considerations.

Vallentyne, John R. *The Algal Bowl: Lakes and Man.* Ottawa: Environment Canada, Fisheries and Marine Service, 1974. Paperback, 186 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A OS9), catalogue No. F 54-31-22, $3.75.

This is a book for non-specialists about lakes and how they are affected by nutrients derived from human activities (man-made eutrophication). The nine chapters cover: the biological classification of lakes and the role of phosphorous and nitrogen compounds in stimulating the growth of algae and aquatic weeds; historical accounts of man-made eutrophication in Lake Zurich, Lake Erie and four Lakes near Madison, Wisconsin; how the vertical circulation of water in lakes is regulated by the action of sun and wind; inter-relationships among carbon dioxide, oxygen and organic matter in natural waters; phosphorous in the biosphere; methods for control of man-made eutrophication; detergent phosphates in the cause and control of such eutrophication; the 1970 controversy over NTA (nitrilotriacetate) as a replacement for sodium triphosphate in detergents; and a view that man-made eutrophication is better regarded as a sign of a deeper Faustian problem than as a problem in itself. While the central theme of the book is that phosphorous is the key to controlling man-made eutrophication, an analysis of ultimate causes shows the need to control "demophoric" growth (combined population and technological growth). Additional material is appended for the more scientifically inclined reader.

Welch, D.M. *Land/Water Classification: A Review of Water Classification and Propsoals for Water Integration into Ecological Land Classification.* Ecol. Land Class. Series No. 5, Ottawa: Environment Canada, Lands Directorate, Sept. 1978. 54 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9). $4.50 ($5.40 outside Canada).

Although many ecological land surveys have been conducted in Canada, few have integrated water resources in their analytical approach. Yet at this point it is uncertain how aquatic data should be integrated with bio-physical data. This report makes a valuable contribution to the problem of bringing together water and ecological land classifications. It describes current approaches to integrated land and water classification and survey; reviews parameters useful and, feasible to collect; and attempts to describe integrated units of land and water at various levels of mapping.

Yanggen, Douglas A. and Born, Stephen N. *Understanding Lakes and Lake Problems.* University of Wisconsin-Extension (215 North Brooks St., Madison, WI 53706), Extension Publication 62411, 1972. 40 pp.

Prepared as part of a program under the Inland Lakes Project (also available is a set of 75 colour slides with narration), this paper discusses basic aspects of lake ecosystems emphasizing interrelated resource management issues. Water quality problems, shoreland development concerns and user conflicts are surveyed and some solutions are suggested.

3.4 Marine Coastal Zone

Few environments bring so sharply into focus the close relationship between man's activities and the functioning of ecosystems as does the coastal zone, the interface between land and water resources. The concept of the "coastal zone" arose from the need to reconcile conflicts between marine coastal ecosystems, which provide a valuable but vulnerable resource base in those parts of Canada fronting on the sea (Nova Scotia alone has some 7 400 km of shoreline), and the many activities which take place in coastal areas.

Ecologically, the coastal zone has two distinguishing characteristics: high biological productivity and wide biotic diversity.

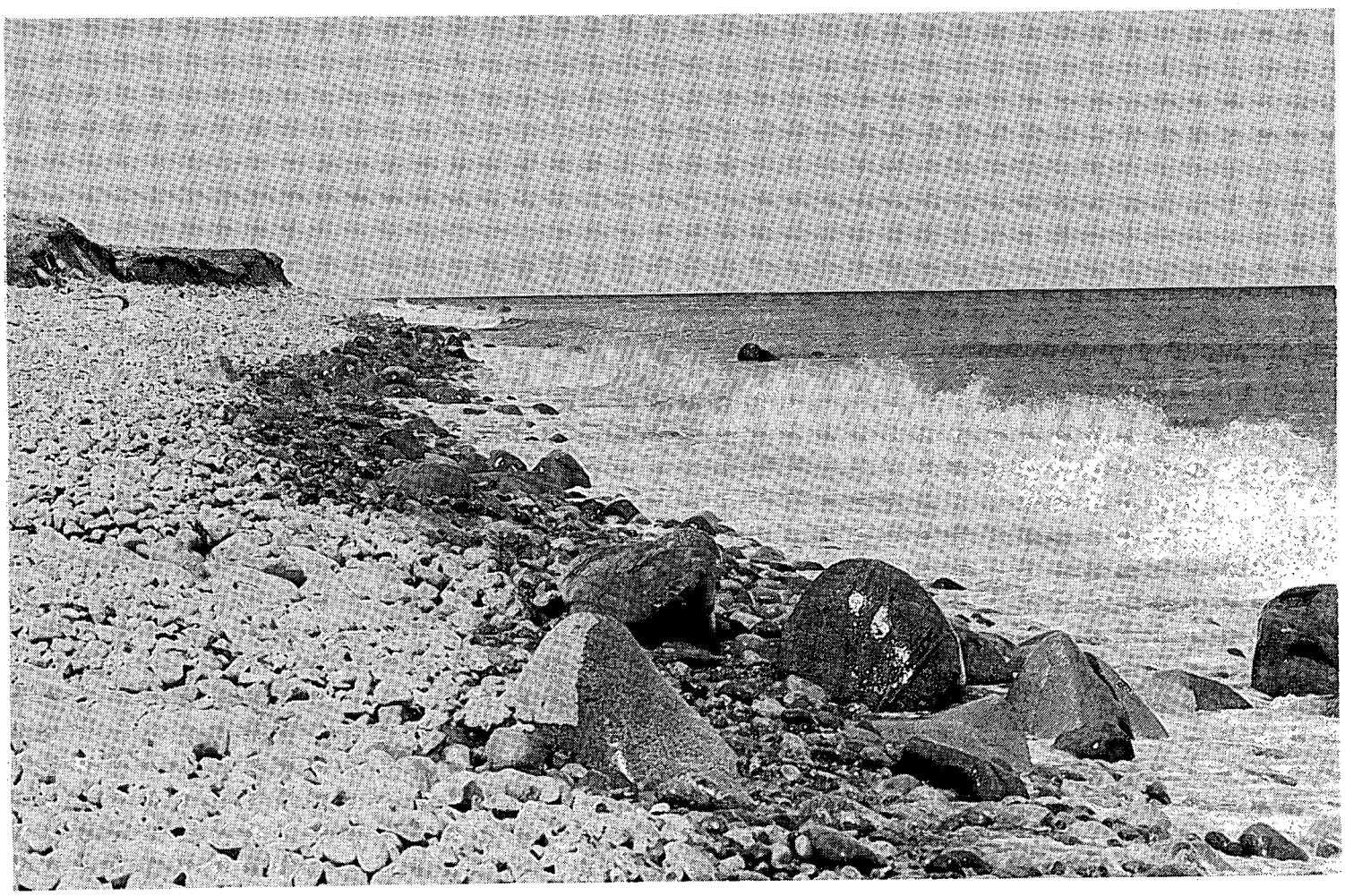
The productivity of coastal wastes results from three interrelated factors. Nutrients from rivers, aquifers and land surfaces wash into coastal waters where they are captured temporarily by a combination of tidal action and biological processes (e.g. uptake by algae). At the same time organic debris from salt marshes, tide flats and other coastal features is added to the nutrients and base. With a good supply of essential nutrients and carbon dioxide, photosynthesis in shallow coastal waters can be very efficient. Biological productivity is further enhanced by the periodic covering of mixed fresh/salt water provides ample access to air and moisture.

Variety and diversity of species can be attributed to two factors. First, as a land-sea ecotone, a coastal zone contains species common to both environments together with a number of very adaptable species that have colonized the transitional area. Second, the coastal zone is a well-stratified environment offering a wide assortment of habitats and niches such as estuaries, tidal wetlands, tideflats, beaches and dunes.

Acknowledgements 3.4

This section includes contributions from:

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Ken Redpath
Brian Wilkes
Phil Wood



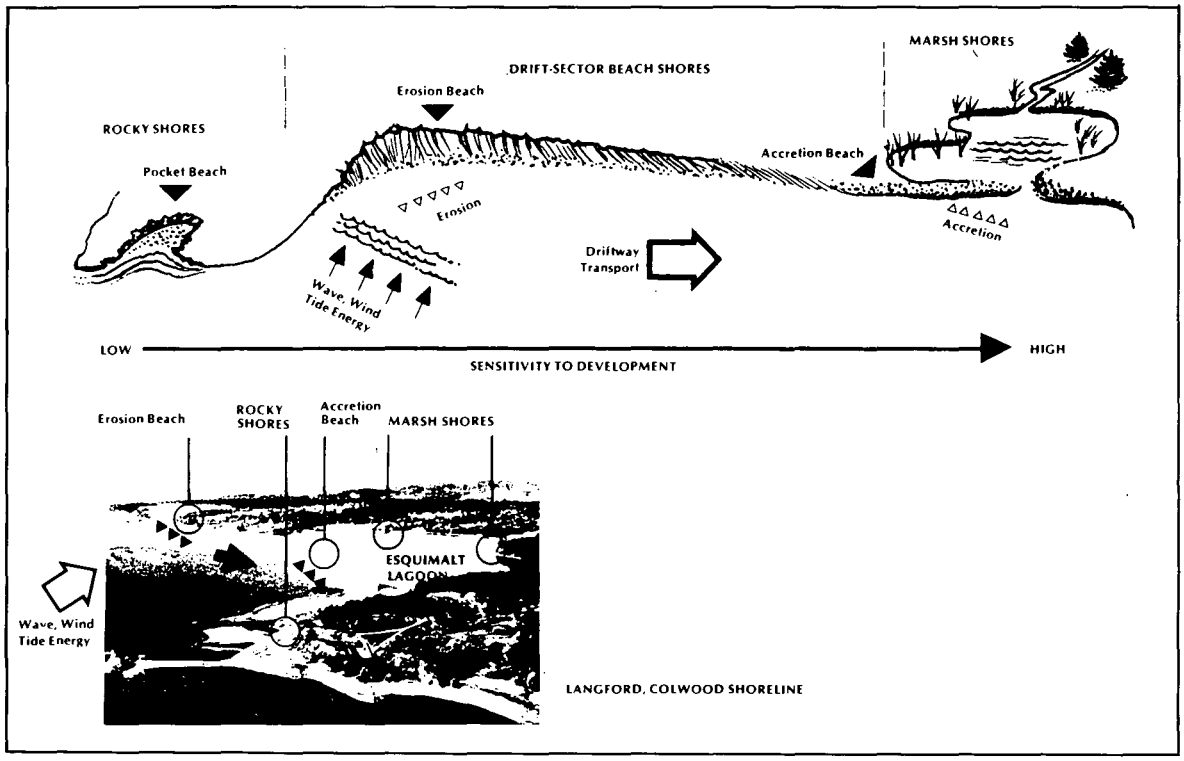


Figure 3.4 Physical and Biological Shore Classification

Source: Capital Regional District, *Coastal Management: The Marine Shorelands of the Capital Region* (Victoria, B.C.: The District, n.d.).

An estuary is a semi-enclosed area along the coast where the fresh water of streams and rivers drains into the sea. It is a nutrient-rich habitat favourable to many plant and animal species. Life in the estuarine environment is shaped by two other factors – current and salinity. Many animals need the lowered salinity in estuaries for spawning, for use as nursery areas, and for protection from predators and competing species unable to tolerate the diluted sea water. Current and salinity, regulated by tides and winds, can be seriously affected by shoreland development which alters the amount and quality of fresh water draining into the estuary.

Tidal wetlands or salt marshes are unique communities of distinctive plant associations usually occurring in the shelter of spits and offshore bars and islands. Salt marshes serve a number of important functions. Many fish species (salmon, for instance) spawn or spend part of their life cycle in tidal wetlands. Certain waterfowl use the marshes as breeding grounds. Wetlands also act as pollution filters, removing contaminants from water flowing through them. And they can reduce shore erosion and flood damage to upland structures by slowing flood waters.

Tidal flats result when stream-carried sediment is deposited in the quiet-water areas of an estuary. Low tide exposes an unvegetated, seemingly barren sandy or muddy surface. Underneath it are millions of micro-organisms, which serve as natural filters for polluted waters, and often large populations of worms, crabs and clams. At high tide these species leave their burrows to feed and fish move in to graze on the exposed food supply.

Estuaries and marshes of tidal flats are a single production unit. Marshes produce an excess of organic material. Daily movement of salt water in and out of the marshes flushes dead plant matter and micro-organisms into the estuarine waters where they become available to a host of decomposers and other detritus feeders. Excreted organic particles eventually become buried in the estuary bottom to create an aerobic environment. Here bacteria go to work, further breaking the material down into essential nutrients.

Beaches and dunes comprise the final important component of the coastal zone environment. They protect salt marshes and uplands from the harmful effects of storms. The sand acts as a

shock absorber, breaking the energy of the waves as they attack the shoreline. Beaches respond directly to the constantly changing energy regime of the ocean. Sand is shifted back and forth, expanding and contracting the beach area. Two restorative processes ensure the regional constant supply of sand: dune formation and littoral drift. The action of tidal currents and of waves striking the shoreline at an angle slowly moves sand and other material along the shore, resupplying eroding beaches with sand. Winds blowing inland over the foreshore move sand behind the beach to form dunes. Grasses and other vegetation help to anchor the sand and reduce wind erosion; in severe storms dunes form the final line of protection against the sea. Maintenance of the sand supply is essential to beach and dune continuance. Actions that threaten the continuity of supply (such as careless beach-located recreational developments) or remove the material (e.g. for use as aggregate in construction) can have disastrous consequences.

Coastal zones are among the earth's most dynamic natural systems. They are also quite vulnerable to man's impact. Coastal development can adversely affect estuarine circulation patterns, water quality, the diversity of marine organisms, wildlife habitat and beach dynamics. Four key problems caused by improper shoreland development are:

Erosion: causes turbidity which can decrease the productivity of adjacent waters (although it sometimes does the opposite) and reduce the oxygen available to aquatic species.

Increasing the flow of freshwater: results in fewer nutrients "captured" by salt marshes to feed their aquatic life, and less sediment deposited in the estuary.

Reducing the flow of freshwater: changes the salinity of estuarine waters which can kill coastal vegetation and radically reduce marsh productivity.

Pollution, especially from domestic sewage from unregulated cottage and recreational/tourism developments.

The impacts of development on the coastal zone are often quite pronounced, direct and visible. Estuaries have been dredged and filled in to create waterfront, industrial, residential and recreational sites. Tidal marshes, often regarded as wasteland, have been ditched, drained or filled for real estate and industrial purposes or used as garbage dumps. Dunes have been levelled for residential development or lowered so that the "view" from the shore would not be obstructed. Coastal waters have been polluted by chemicals, pesticides, sewage and silt washed from inland areas or dumped directly into estuaries and wetlands.

The combination of strong, often-unpredictable natural forces (Dolan) and equally strong pressure for human activity in the coastal zone creates an especially urgent demand for careful coordinated environmental planning and management. The key to minimizing the impacts of human activities on the coastal zone is to retain, in both the short and long term, the diversity of species, habitats and functions that coastal zones provide.

Case Study 43
Burrard Inlet Ecological Study, Port Moody, B.C.

The terms of reference for this 1972 study were: to identify and relate the most important elements of the Burrard Inlet Tidal Flats and Noon Creek ecological system; to establish priorities for retaining these elements; and to identify the various levels of impact that the alternative forms of probable development would have. The environmental evaluation process is involved in identifying elements of the Burrard Inlet ecosystem, rating their relative importance and assessing the impacts of various uses of the Inlet on the natural habitats using identified ecological objectives as the basis for evaluation. Measures used to determine the effectiveness of the ecosystem and the importance of alternatives land uses were: (a) the relative importance of a sub-area for a life form and the relative importance of the flora for a sub-area; and (b) the relative impact of uses on the habitat in terms of a *habitat sensitivity factor* and a *habitat/use compatibility factor.*

The ecological evaluation method had three steps:

1. Rate the importance of various sub-areas in Burrard Inlet for flora and fauna on a four-point scale.
2. Determine the relative magnitude and impact by assessing, first, the relative carrying capacity of each environmental sub-area in terms of its sensitivity to human activities, and second, the compatibility of land uses

with each environmental sub-area. The relative magnitude of impact was determined by applying the following formula:

$$\frac{\text{Relative inherent eco-value of subtidal area}}{\text{Subtidal area's relative sensitivity to use}} \times \text{Relative Compatibility of use} = \text{Relative Magnitude of use}$$

3. Compare the sub-area's inherent ecological value with the area's potential appreciated value if the land were used for another purpose:

$$\text{Relative magnitude of impact} - \text{Relative inherent eco-value of subtidal area} = \text{Accrued gain or loss}$$

Refer to:
M.H. Lindeman, *Burrard Inlet Ecological Study for the City of Port Moody* (Vancouver: EIKOS Consultants Ltd., 1972).

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Case Study 44
Protecting a Coastal Wetland in P.E.I.
Submitted by Philip Wood, P.E.I. Land Use Service Centre

Deroche Pond is a large freshwater/saltwater inland (backshore) wetland on the north shore of Prince Edward Island abutting P.E.I. National Park near Tracadie Bay. The area is considered to be the most important waterfowl breeding and migratory area in the province. Significant for its abundant plant and animal life, the pond represents a prime example of a dune and wetland system.

Pressure for cottage development and day use of the beach has grown substantially in the last few years. Wildlife interests in the province are greatly concerned. The provincial government and the Canadian Wildlife Service attempted several times to purchase the entire wetland but the price was excessive.

The Cabinet decided instead to buy only the most sensitive lands with development potential. Planning Act regulations are considered to be capable of effectively controlling development on wetlands, and it is expected that adequate buffers can be established through negotiation with cottage subdivision agreements. A biophysical analysis, which helped identify areas with and without capability to sustain development as well as lands to be purchased, will become an ongoing tool for development control in the area.

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Case Study 45
Beach Resources Study, Eastern New Brunswick
Submitted by Nancy McInnis, Environment New Brunswick

Beach quarrying activities are a long-standing coastal zone problem in New Brunswick. Northumberland Strait's many accessible sand beaches have been subjected to intense quarrying since 1945. Beach material is in demand for such uses as highway construction, railroad friction sand and fine aggregate for concrete. A study undertaken for the New Brusnwick Department of Natural Resources (below) determined, "Beach quarry activities have resulted in adverse disruption of natural dynamic beach equilibrium with rapid recession of barrier beaches (up to 10 ft./yr.), accelerated erosion of local sandstone headlands, loss of salt marsh and estuary ecological habitat, and impairment of recreational beach quality."

Prior to completion of the study in 1975, little was known about coastal processes and features, cause-effect relationships between beach quarrying and changes in coastal areas, and current coastal planning concepts. Lack of this knowledge made it impossible to effectively manage the use of coastal uses and prevent further degradation. Environmental data were presented by the study in a series of easily used, small-scale maps (available through the Department of Natural Resources).

Among the study's recommendations only those relating directly to the beach quarrying problem have been acted upon. All New Brunswick shore areas lying outside Crown land have been brought under The Quarriable Substances Act and a policy of restricting quarry permits to inshore areas is being enacted. Implementation of further recommendations is not probable due to

their broad nature and the jurisdictional ambiguity. Instead, their primary function is as guidelines to coastal development.

Refer to:
Garry T. Hunter, *Beach Resources, Eastern New Brunswick* (Toronto: Airphoto Analysis Associates, 1975). Available from Minerals Branch, New Brunswick Department of Natural Resources.

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(506) 453-2206

Information Resources

See also:
2.3 Water Quality, Water Quantity and Urban Runoff
3.2 Inland Wetlands

Bauer, Wolf. *Case for the Low-Gradient Estuaries.* n.d. 11 pp. Unpublished.

The author, a consultant on the west coast (6522 Seaview Ave. NW, Seattle, Wash. 98107), has undertaken various site-specific coastal zone analyses in British Columbia. Using a system for describing coastal process (sedimentation, currents, tides, etc.) the author comments on the effects of erosion and accretion on the coastal zone and interprets effets of various types of development proposals.

B.C. Land Resources Steering Committee. *The Management of Coastal Resources in British Columbia. Vol. 1: State of the Art. Vol. 11: Review of Selected Information.* B.C. Land Resources Steering Committee (c/o Dr. Les Lavkulich, Dept. of Soil Sciences, University of British Columbia, Vancouver V6T 1W5), 1977.

Capital Regional District and B.C. Ministry of the Environment, Land Management Board, Environmental Services Unit. *Coastal Management: The Marine Shorelands of the Capital Region.* Capital Regional District, Planning Department (P.O. Box Drawer 1000, Victoria V8W 2S6), n.d. 12 pp.

A brochure outlining the need to manage the marine shore of the region, the basis for such management, and physical and biological characteristics of shore types. General guidelines for shoreland development are outlined and a six-step course of action is suggested for the District, located on the south end of Vancouver Island.

Clark, John. *Coastal Ecosystems: Ecological Considerations for Management of the Coastal Zone.* The Conservation Foundation (1717 Massachusetts Ave. NW, Washington, DC 20036), 1974. Paperback, 178 pp. $4.00.

Clark, John. *Coastal Ecosystem Management: A Technical Manual for the Conservation of Coastal Zone Resources.* New York: Wiley, 1977. Hardcover, $38.00.

Clark, John. *The Sanibel Report: Formulation of a Comprehensive Plan Based on Natural Systems.* The Conservation Foundation (1717 Massachusetts Ave. NW, Washington, DC 20036), 1976. Paperback, 305 pp. $9.00.

This comprehensive document deals with an 11 000-acre barrier island off the gulf coast of Florida. It covers the natural systems thoroughly, then presents a plan (by Wallace, McHarg, Roberts and Todd) for its conservation and development. Appendix 5, pages 271-294, specifically addresses estuarine ecology. Further annotated in 5.4 Plans and 2.7 Energy.

"Coastal Energy Impact Program, Project Assessments and Environmental Impact Statements: Environmental Guidelines for Preparation", *Federal Register*, Vol. 42, No. 171, 2 Sept. 1977, pp. 44 400-44 404.

These guidelines provide coastal states and local communities with a detailed description of the environmental information necessary as part of their applications for certain kinds of assistance under the Coastal Energy Impact Program (Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, Room 372, 3300 Whitehaven St. NW, Washington, DC 20235).

Daborne, G.R. (ed.). *Fundy Tidal Power and the Environment.* Acadia University Institute (Acadia University, Wolfville, N.S.), 1977.

Proceedings of a November 1976 conference on the potential exploitation of the Bay of Fundy tides for electric power purposes. The conference emphasized the lack of basic information and knowledge needed before a go/no go decision could or should be made on this massive project. An overview document, prepared by Beak Consultants for the federal-provincial Fundy Tidal Power Review Board as the last phase of environmental assessment for this potential project, came to a similar conclusion. It underlined the lack of knowledge concerning biological productivity of the area, the importance of salt marshes, migratory bird populations, and the interaction of the tidal system with agricultural fisheries, recreational and wildlife activities in the vicinity. Phase 2 studies are now getting underway (see Bay of Fundy Tidal Power Environmental Assessment Panel, referenced in 4.7 Energy Projects).

Dolan, Robert et al. *Handbook for Remote Sensing: Mid-Atlantic Coast, Natural Seashore, Assateague Island, Cape Hatteras, Cape Lookout.* NASA/Wallops Flight Centre (Wallops Island, VA 23337) and National Parks Service (U.S. Dept. of the Interior, Washington, DC 20240), Natural Resources Report No. 10, 1977. 114 pp.

The NASA/Wallops Island Flight Centre is the focal point for barrier-island and wetlands remote sensing research in the mid-Atlantic area. This report summarizes the use (selection and application for mapping and monitoring) of several types of remote sensing imagery in the investigation of coastal phenomena. A case study of the Assateague Island National Seashore is presented. It summarizes two conclusions from the 30-year experience of the NPS in administering coastal park areas. First, management actions designed to control and stabilize the

natural modifications of the landscape by marine forces usually result in unexpected side-effects that in turn require additional management action. Second, management actions to control the landscape have been found to be site-specific and therefore procedures that were successful in one location are not necessarily successful in another; nor do they result in the same effects when applied elsewhere, because of the regional nature of the forcing processes. Careful monitoring is essential.

Ducsik, Dennie W. *Shoreline for the Public: A Handbook of Social, Economic and Legal Considerations.* Cambridge, MA: MIT Press, 1974. Hardcover, $12.50.

Ecological Sub-Committee, Vancouver International Airport Planning Committee. *An Environmental Impact Assessment of the Vancouver International Airport Expansion: A Summary Report.* Environment Canada, Lands Directorate, Environmental Management Service (1001 West Pender St., Vancouver V6E 2H7), 1976.

An assessment of the environmental impact of the expansion of the Vancouver Airport on the Fraser River Estuary Delta was carried out from 1974 to 1976 by the Department of the Environment under the auspices of the Ecological Sub-Committee. The report provides important ecological information on the resources of the Fraser River Estuary/Delta. It documents the competing and often conflicting resource uses, the environmental issues and the accelerating pressures for continued use of the Delta area. A key finding was that past developments and present use of the Delta have led to significant changes in that environment. Existing information and knowledge do not permit a reliable assessment of the actual degree of danger to the ecological viability of the estuary/delta inherent in the implementation of any further developments.

Environment Canada. *Coastal Zone: Framework for Management in Atlantic Canada.* Environment Canada (Ottawa K1A 0H3), 1975.

Fox, F.K. and Nowlan, J.P. *The Management of Estuarine Resources in Canada.* Canadian Environmental Advisory Council (Environment Canada, Ottawa K1A 0H3), Report No. 6, 1978. 60 pp. Free.

This report addresses the problems of managing the resources of estuaries and associated ponds. Considering the importance of these resources to Canada, it examines why such management has not occurred in a manner compatible with the public interest. Management problems are illustrated with case studies of four specific estuarine areas.

Hous, L.M. and Packman, G.A. *The Fraser River Estuary: States of Environmental Knowledge to 1974.* Environment Canada (Ottawa K1A 0H3), Sept. 1974.

This publication is one of a series commissioned by Environment Canada for estuaries on the British Columbia coast (others are available for Campbell, Cowichan, Kitimat, etc.). Each volume reviews, for that estuary, published and unpublished literature on all aspects of the biophysical environment and the human imprint (land uses, etc.) See also: Fraser River Estuary Study, referenced in 5.4 Plans.

Johnston, D.M., Pross, A.P. and McDougall, I. *Coastal Zone Framework for Management in Atlantic Canada.* Institute of Public Affairs, Dalhousie University (Halifax, N.S. B3H 1X2), 1975. 199 pp.

Commissioned by Environment Canada, Inland Waters Directorate, this volume includes a discussion of existing Canadian legislation relevant to coastal zone management in Atlantic Canada, various agencies that have jurisdiction and/or activities in the coastal zone, and available administrative options. Defining "the coastal zone" (how far landward, how far seaward) is itself a difficult problem.

Ketchum, H.B. (ed.). *The Water's Edge: Critical Problems of the Coastal Zone.* Cambridge, MA: MIT Press, 1972. Hardcover, 254 pp. $15.00.

McHarg, Ian L. *Design With Nature.* Garden City, NY: Doubleday/Natural History Press, 1971. Paperback, 197 pp. $6.95.

The chapter on "Sea and Survival", pages 6-17, discusses the coastal zone, especially dunes.

Meyer, Philip A. and Dolphin, Daniel R., "A System for Determining Economic Loss Associated with Estuary Degradation", *Coastal Zone Management Journal,* Vol. 3, No. 4, 1977, pp. 305-404.

Nassau-Suffolk Regional Planning Board. *Integration of Regional Land Use Planning and Coastal Zone Science.* The Board (H. Lee Donnison Office Bldg., Veteran's Memorial Highway, Hauppauge, NY 10022), 1976. Paperback, 307 pp. Availability uncertain.

Develops an "integrated methodology" capable of analyzing environmental problems that exist or may occur as the result of land uses in the coastal 3 one, combining 12 methods: Land Use Data System; Waste Generation Rates; Transport Coefficients; Pollution Susceptibility; Biological Constraints; Environmental Constraints; Waste Treatment Evaluation; Coastal Zone Modelling System; Cause-Condition-Effect; Economic Analysis; Political Analysis; and Legal Analysis. Using the Integrated Methodology, planners can identify (a) regional coastal water quality problems in water bodies where pollutant concentrations exceed tolerance levels of key marine species, and (b) land use alternatives (changes in the type/location/intensity of land use, waste management strategies, environment modifications, etc.). A case study of the Nassau-Suffolk Comprehensive Development Plan illustrates application of this approach.

Ontario Ministries of Housing, Environment and Natural Resources. *Lakeshore Capacity Study, Progress Report.* Ministry of Housing, Local Planning Policy Branch (36 Wellesley St. W, Toronto M7A 2K4), Feb. 1978. Free (supply limited).

Presented as a Case Study 40 in 3.3 Lakes. See Section 6.0, "Fisheries-Littoral Zone Study", which includes an extensive literature review of publications on the environmental effects on the littoral zone of various shoreline and lake activities (cottage development, outboard motor use, housing and recreational development, logging, dredging and channelization, water level manipulation, erosion and siltation, etc.). Biological/environmental responses to these activities and to natural phenomena are discussed.

Québec, Conseil consultatif de l'environnement. *Aménagement des berges, des lacs et de rivières au Québec.* Conseil consultatif de l'environnement (1020, Saint-Augustin, Québec, Qué. G1R 4Z4), juin 1976. 202 pp.

An analysis of the problems associated with shorelines of lakes and rivers with emphasis on the institutional arrangements necessary to bring these problems under control. In this report the Council outlines its recommended approach, techniques and principles of shoreline management.

Rees, W.E. and Davis, H.C., "Coastal Ecosystem Planning and Impact Evaluation", in American Society of Civil Engineers. *Coastal Zone '78, Vol. 11.* ASCE (345 E 49th St., New York, NY 10017), 1978.

Volumes I-IV (Vol. IV pending) resulted from a symposium on technical, environmental, socio-economic and regulatory aspects of coastal zone management.

Richardson, D.K. *The Cost of Environmental Protection: Regulating Housing Development in the Coastal Zone.* Transaction Books, 1976. 219 pp. $10.00.

Sorensen, Jens C. *A Framework for Identification and Control of Resource Degradation and Conflict in the Multiple Use of the Coastal Zone.* University of California, Department of Landscape Architecture, College of Environmental Design (Berkeley, CA 94720), 1971. 40 pp.

Sorensen, whose work has influenced methodology in environmental impact assessment, presents in this M.Sc. thesis a stepped-matrix approach for assessing cause-condition-effect in the coastal zone of California. The initial step in preparing the matrix was a listing of known examples and types of coastal resource degradation or use-conflict in California. Each listing was then traced back by effect-condition-cause factoring to a resource use. Proposals for application of the matrix are included.

Southeastern Wisconsin Regional Planning Commission. *Floodland and Shoreland Development Guide.* SWRPC (Old Courthouse, Waukesha, WI 53180), 1968. 199 pp. Out of print; check with SWRPC Planning Library.

This guide (aimed at freshwater shorelines but with applicability to marine shores) explains methods and means available to prevent flood damage and protect water quality. It then presents model regulations and other mechanisms for implementing regional, watershed and district land use

plans. Floodland and shoreland problems are discussed in detail.

Teal, John and Mildred. *Life and Death of the Salt Marsh.* Boston: Ballantine, 1974. Hardcover, 219 pp. $10.00.

Welch, D.M. *Land/Water Classification: A Review of Water Classifications and Proposals for Water Integration into Ecological Land Classification.* Ecol. Land Class. Series No. 5, Ottawa: Environment Canada, Lands Directorate, Sept. 1978. 54 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9). $4.50 ($5.40 outside Canada).

Includes a discussion of classifications and inventories for lakes, rivers and shorelines.

3.5 Scenic Areas

Since most of our impressions of the world come to us through our eyes, it is not surprising then that amenities, visual resources and scenic areas are increasingly prominent among environmental concerns. They are difficult to handle, though, and because so much subjectivity seems to be involved ("it's in the eye of the beholder") they are often shunted aside as superficial when compared with other environmental problems. Yet the visual impression may be the closest the average person comes to a holistic view of his or her environment. Considerable opportunity exists to widen this perception – visual impression can be altered by additional information – and the related environmental awareness. Moreover, knowledge and experience are rapidly emerging from the design, behaviourial and perceptual fields that enable visual concerns, both subjective and objective, to be given more deliberate consideration in environmental planning and assessment.

Acknowledgements 3.5

This section includes contributions from:

Dirk Blyleven
David Brown
Ray Crook
Klaus Ohlemann
Ken Redpath
Alan Vaughan

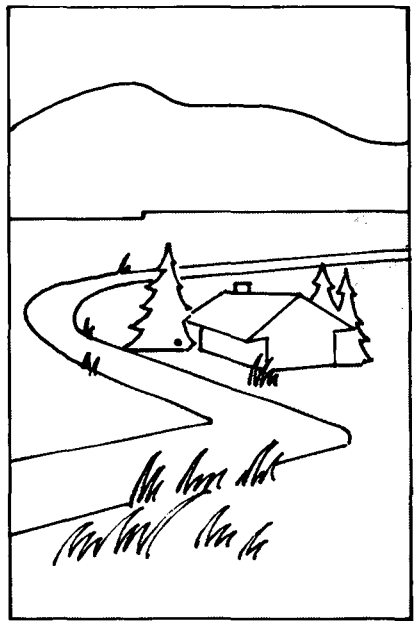


Figure 3.5 Form, Line, Colour and Texture in a Landscape

A key question for planners is how to determine what constitutes a scenic resource. The *character* of a landscape, i.e. the overall impression it creates, is important. It is said to be determined by form, line, colour and texture which interact and compete for dominance. Another significant factor is *variety*, too much or too little of which can be equally unpleasant; variety can be introduced by changes in colour, topography, structural form, vegetation size or

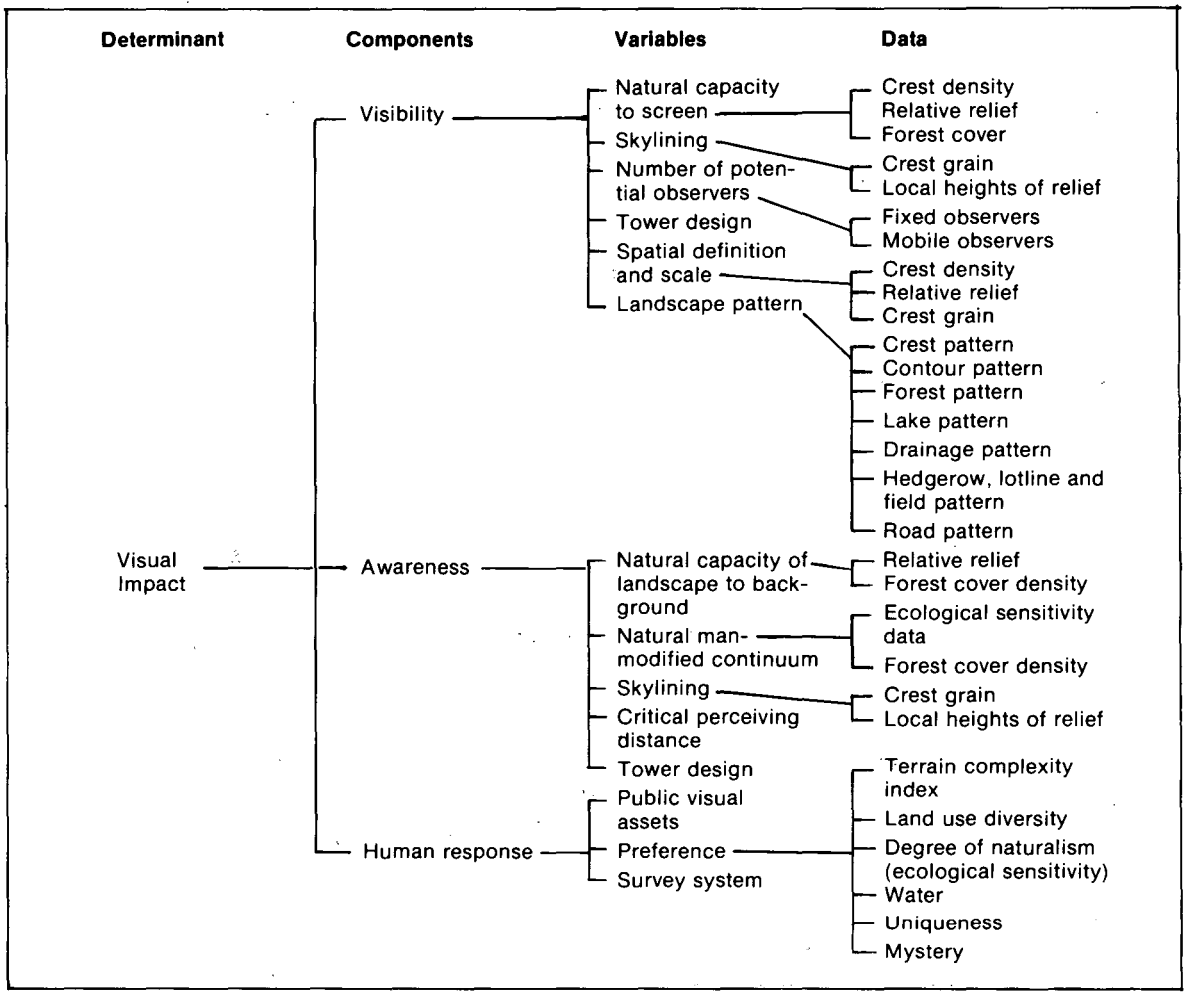


Figure 3.6 A Visual Information System

Source: University of Guelph, Centre for Resources Development, *Location Hydro* (Guelph, Ont.: The Centre, n.d.)

type, and so on. Also requiring consideration are the *characteristics of the people* in a given area (their backgrounds, what they recall, expect, etc.) and the *cultural setting* which affects the meanings people attach to what they see (what is visually desirable in one place or to one group may not be in or to another). Another significant factor is *scale* – the relative size of things, the relationship between space, dimensions and people.

Classification systems and visual-quality assessment techniques for identification, quantification and evaluation have been developed based on the interplay of the foregoing factors and others (Litton, Zube, Leopold, Lynch, etc.). For example, in a recent study of overhead transmission lines for Ontario Hydro, the Centre for Resources Development at the University of Guelph defined visual impact as "a perceivable physical change to the landscape that results in a negative human response". Three components of visual impact were identified: visibility (how much does the observer see) awareness (how much of what the observer sees is he cognizant of) and human response (how does he value what he sees and is aware of). That is, for a feature of the landscape to be deemed visually significant, it has to be seen by a significant number of people, observers have to be aware of it, and they must perceive it to have value. Each component was addressed objectively and subjectively in the study method, to determine aesthetic quality, which was then established as the major criterion for determining the location of overhead transmission lines.

Sub-component	Goals/ Objectives	Impacts	Necessary information	Methodology	Findings / Measurements	Standards/ Guide lines
Visual Content	Sense of time and place; social and civic attachment.	Will the content of the visual scene perceived by the residents of the surrounding area be adversely affected by the project? Will the visual content of the surrounding area have an adverse effect on project residents?	Project plans; site observations; signing; building design characteristics; pictorial images, etc.	Photographic analysis of intrusion; semantic differential techniques; standard classification for landscape analysis; open ended questions.	Analyst-defined scales of visual intrusion; design compatibility; urban character, etc.	
Area and Structural Coherence	Clarity of area structure; sense of harmony; integration of activities.	Will the coherence of the surrounding area be reduced by the project action?	Plan, building and landscape descriptions; visual observations.	Descriptive evaluation; sketch mapping.	Activity-image map; judgment of coherence.	
Apparent Access	Access to activities and areas.	Will the project obscure or eliminate access information required for the use of activities and areas?	Visual observations; project plan.	Descriptive evaluation of observed diversity of activity; access to window displays, etc.; question users.	Judgment of access to activities and areas of interest and use.	

Figure 3.7 Visual Quality Environmental Assessment Summary Table

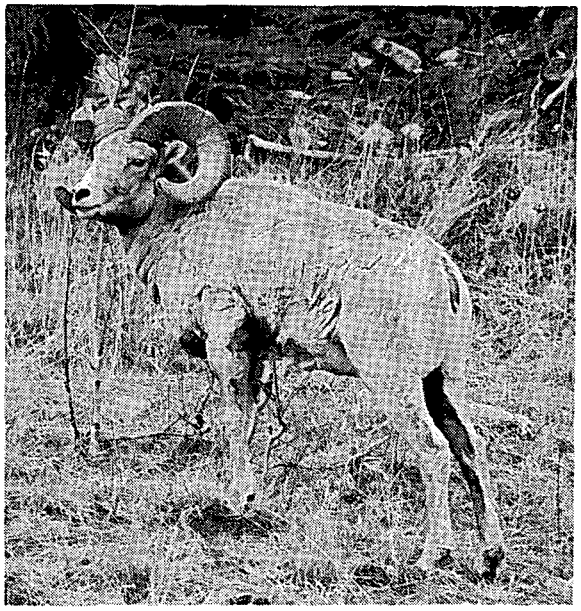
Source: Planning Environmental International, *Interim Guide for Environmental Assessment. HUD Field Office Edition* (Washington, D.C.: U.S. Dept. of Housing and Urban Development, 1975.

Conventional approaches to visual-resource planning include inventory and evaluation of 1. site-specific features, such as waterfalls and scenic vistas; 2. aesthetic quality, visually based on subjective scoring systems; 3. landscape "absorptive capacity", a combination of the degree of visual penetration and visual complexity. Each approach has merits but none has proved to be fully satisfactory. Difficulties exist in integrating the role perception plays in determining visual quality, and deciding what factors affect perception and which can be inventoried and evaluated.

Issues surrounding perception of environmental quality (discussed in 1.2 Characteristics of Environmental Problems) are central in dealing with scenic areas in environmental planning and management. While beauty and ugliness contain strong subjective components, experience of practitioners and researchers in the visual assessment field suggests that general agreement can be secured on the aesthetic quality of a given landscape. Certain general guidelines or hypotheses can be set for use or testing in specific situations. Three examples: the capacity of a landscape to provide aesthetic experiences is essentially derived from its intrinsic qualities; people's preferences for and evaluations of landscapes can be expected to change over time; as the amenity value rises but the amenities themselves diminish in quantity and quality (due, perhaps, urbanization pressures on the countryside), concern over aesthetics will increase even further.

One difficulty that arises is the existence of an urban-oriented aesthetic sensibility that prizes neatness, order and manicured landscapes. The tendency is to transfer this aesthetic to non-urban areas, thereby creating pressure to drain "ugly" swamps, line up trees in a row, import alien species that diminish diversity, etc. Much of this has to do with a lack of awareness of how environments work in cities, in the countryside and in wild areas.

If planners and others can respond to the need to increase environmental awareness as an integral part of their work, and if aesthetic judgement can become less esoteric (the domain of the few with special training or "good taste") without becoming either totally subjective or overly "scientific" (taking account only of those facts which can be measured), then the opportunity to use it in environmental planning/management can be considerable.



Case Study 46
Visual Analysis of Overhead Transmission Corridors
Submitted by Alan Vaughan, Parks Canada (formerly of Ontario Hydro)

Landscapes have cultural significance. They represent a living visual record of our work and leisure habits; through observation we gain knowledge from this record concerning ourselves and the environment. Untouched areas form an essential foil to man-modified landscapes. Certain human intrusions, such as transmission lines, can permanently alter the character of these landscapes, resulting in the loss of something valued.

Accordingly, Ontario Hydro searched for a visual analysis system that: (a) was based on a conceptual framework equally applicable at the provincial, regional and local levels of investigation, (b) was relevant to the large diversity of Ontario landscapes, and (c) if applied by different personnel would result in similar conclusions. Since no single existing method satisfied the requirements, a new system was developed based on the premise that each area presents its own unique visual image and that a transmission line will have a predictable effect on that image. Visual impact is defined as the predicted disruption to the existing image of an area caused by the proposed development.

The resulting visual analysis system does not assign a relative degree of "beauty" to any area. Most people's aesthetic judgements are based on emotional, cultural and historic factors. Valid judgements of visual significance are limited by the length of time current values remain constant and by the congruence of the viewer's judgement with the prevailing consensus. The system used by Ontario Hydro, therefore, is derived from the "process" by which people perceive and form visual images of their environment. Working with the relevant factors that determine man's relationship with his total visual environment rather than a subjective concept of beauty makes it possible to formulate factual recommendations for the location of transmission corridors that will minimize undesirable changes.

Three steps determine the perceived impact of a transmission line on the visual quality of the landscape. First, physical change to the character of the landscape is predicted; second, by considering people's variable attentiveness (i.e. sensitivity) and the identified degree of physical change from Step 1, the perceived impact on landscape character can be predicted; and third, consideration is given to the number of people who will view the visual disruption. The product of the visual analysis method is a map depicting areas where a transmission line could be located with least perceived change to landscape character.

The method, transferrable to other types of development provided that trainable personnel are available, has gained the acceptance of other professionals and various interest groups as an appropriate technique for dealing objectively with visual resources when selecting locations for transmission corridors. The lack of specific public support for protecting the visual character of Ontario's rural and natural landscape, however, has meant that visual resources generally have not been prime determinants in the location of transmission corridors. Publics have not readily accepted the method, perhaps due to its complexity and the unconventional nature of an approach not based on "beauty".

Refer to:
A Background Paper for the Workshop on Visual Impact, Alan Vaughan, Ontario Hydro, 1973

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Information Resources

See also:
1.2 Characteristics of Environmental Problems

Appleyard, Donald, Lynch, Kevin and Meyer, John B. *View From the Road.* Cambridge, MA: MIT Press, 1964. Hardcover, $20.00.

Presents a "sequence experience rotation" view applicable to urban settings especially freeways.

Bagley, M., "Aesthetic Impacts-Research and Development", in Hutchings, Bruce et al. (eds). *Environmental Impact Analysis.* University of Illinois at Urbana-Champaign, Dept of Architecture (104 Architecture Building, Urbana, IL 61801), 1975. $5.00.

A short article that arrives at three generalized conclusions about aesthetics in the planning process: (1) many U.S. agencies have been concerned with aesthetics for a long time but they still differ in their philosophical approaches; (2) there is a lack of any clearly defined aesthetic responsibility at different levels of planning; and (3) there is very little indication that any of the aesthetic assessment methods available for use are actually being tried. Elaborated in M. Bagley, *Aesthetics in Environmental Planning*, U.S. Environmental Protection Agency, Office of Research and Development (Washington, DC 20460), EPA 600/5-73-009, 1973.

Battelle-Pacific Northwest Laboratories. *A Technique for Environmental Decision Making Using Quantified Social and Aesthetic Values.* Washington, D.C.: U.S. Atomic Energy Commission, 1974. 189 pp. + app. Available from National Technical Information Service (5285 Port Royal Road, Springfield, VA 22161), BNWL-1787, $9.50.

Annotated in 4.7 Energy Projects.

Craik, Kenneth, "Psychological Factors in Landscape Appraisal", *Environment and Behavior,* Sept. 1972, pp. 255-265.

An overview of the state of the art of landscape appraisal and preference.

Fabos, J.G., "An Analysis of Environmental Quality Ranking Systems", in U.S. Dept. of Agriculture. *Recreation Symposium Proceedings.* U.S. Department of Agriculture, Forest Service, Northeast Forest Experimental Station (Upper Darby, PA), 1971.

Fines, K.D., "Landscape Evaluation: A Research Project in East Sussex", *Regional Studies,* Vol.2, 1960, pp. 41-55.

Fuhriman, Jerry W. and Crozier, Edward. *Planning for Wildlife and Man.* Washington, DC: U.S. Dept. of the Interior, Fish and Wildlife Service, 1975, 55 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Catalog No. 1 49.2: W64/8, $1.10 + 25% outside U.S.A.

One of the objectives of this study was to provide insights into man's reaction to the visual aspects of the wildlife area environment. Section 2, pages 15-45 presents in a straightforward, practical way, a series of land design principles relative to visual aspects of the environment: imageability, spatial structure, variety, views and vistas, dominance, sequence and environmental modifications.

Hare, Richard, "Contrasting Methods of Environmental Planning", in Peters, R.S. (ed.). *Nature and Conduct.* London: Macmillan, 1975.

A useful discussion of the subjective/objective in environmental planning. Subjectivity, objectivity and quality are also explored in depth in the popular book *Zen and the Art of Motorcycle Maintenance* by Robert Pirsig (New York: Bantam Books, 1974).

Harkness, Terence, "Visual Analysis Techniques: Outfitting Your Tool Box", in Hutchings, Bruce et al (eds.). *Environmental Impact Analysis.* University of Illinois at Urbana-Champaign, Dept of Architecture (104 Architecture Building, Urbana, IL 61801), 1975. $5.00.

Visual impacts have been difficult to include in the environmental impact statement process under the U.S. National Environmental Policy Act due to lack of explicit description, abstraction notation, analytic impact organization, quantification/rating and objective evaluation. The article extensively lists and organizes the literature according to its applicability in impact assessment.

Jacobs, Peter and Way, D. *Visual Analysis of Landscape Development.* Harvard Graduate School of Design, Dept. of Landscape Architecture (Cambridge, MA), 1968.

Technique-oriented using vegetation and landform to measure the visual impact of development on the landscape (e.g., how much alteration different types of landscapes can sustain). Provides urban/regional planners with criteria for constraining or complementing development.

Krutilla, J.V. *Evaluating Benefits of Environmental Resources with Special Application to Scenic Resources.* University of Guelph, Centre for Resources Development (Guelph, Ont. N1G 2W1), publication No. 45, October 1971. 45 pp.

An economic perspective on visual assessment, this paper explains the rationale for measuring the value of scenic resources and then applies it to Halls Canyon.

Krutilla, J.V. and Fisher, A.C. *The Economics of Natural Environments: Studies in the Valuation of Commodity and Amenity Resources.* Baltimore: John Hopkins University Press, 1975. Paperback, 292 pp. $4.50.

An economic approach to bringing scenic and amenity resources into an analytic valuation framework comparable to that for extractive resources. Part 1 is devoted to theoretical and institutional considerations. Part 2 is a selection of U.S. case studies.

Leopold, Luna, "Landscape Esthetics: A Method Quantifying Landscapes", *Natural History,* Oct. 1969, pp. 37-44.

Linton, D.L., "The Assessment of Scenery as a Natural Resource", *Scottish Geographical Magazine,* Vol. 84, 1968, pp. 219-238.

Litton, R.B. *Forest Landscape Description and Inventories – A Basis for Planning and Design.* U.S. Dept. of Agriculture, Forest Service, Southwest Forest and Range Experimental Station (P.O. Box 245, Berkeley, CA 94701), 1968. 64 pp.

Presents a method for objectively describing landscapes based on characteristics of both the landscape (form, spatial definition and light) and the landscape observer (distance, position and sequence). These concepts are used to describe major landscape types (panoramic, feature, enclosed, focal, canopied, detail and ephemeral) and methods for landscape inventories. For a continuation of Litton's work see: R. Burton Litton, Jr. et al, *Water and Landscape – An Aesthetic Overview of the Role of Water in the Landscape,* Water Information Center (7 High Huntington, New York, NY), 1974.

Lynch, Kevin. *The Image of The City.* Cambridge, MA: MIT Press, 1960. Paperback, 194 pp. $3.95.

In this classic study of the form, structure, complexity and "imageability" of urban environments, Lynch identifies five elements which can be used to organize and catalogue the visual and functional patterns of an urban environment: *paths,* along which an observer moves; *edges,* linear elements which define areas or present barriers between them; *districts,* larger areas with common identifying characteristics; *modes,* distinct strategic points or foci of activities; and *landmarks,* important reference points.

Rapoport, Amos, "Environmental Cognition in a Cross-Cultural Perspective", in Moore, Gary T. and Golledge, R.G. *Environmental Knowing: Theories, Research and Methods.* Stroudsburg, PA: Dowden, Hutchinson & Ross, 1976. Hardcover, 441 pp. $14.95.

Sargent, Frederic O. *Rural Environmental Planning.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), 1976. Paperback, 199 pp. $7.00.

Chapter IX, "Aesthetics Planning", presents ten concepts and practices which are useful in maintaining an alternative environment through land use planning. Annotated further in 1.3 Characteristics of Environmental Planning.

Sarnoff, Henry, "Measuring the Attributes of the Physical Environment", in Lang, Jon et al (eds.). *Designing for Human Behavior.* Stroudsburg, PA: Dowden, Hutchinson and Ross, 1974. Hardcover, $11.95.

Shafer, E., Hamilton, J.F. and Schmidt, E.A., "Natural Landscape Preferences: A Predictive Model", *Journal of Leisure Research,* Vol. 1, 1969, pp. 1-19.

Simonds, John O. *Earthscape: A Manual of Environmental Planning.* New York: McGraw-Hill, 1978. Hardcover, 340 pp. $24.95.

Chapter 4, "The Visible Landscape", includes a nine-page illustrated case study of visual-resources improvement and preservation

in the city and region of Chattanooga/Hamilton County, Tennessee.

Tetlow, R.J. and Sheppard, S.R.J. *Visual Resources of the Northeast Coal Study Area, 1976-1977.* B.C. Ministry of the Environment, Resource Analysis Branch (Parliament Buildings, Victoria V8V 1X4), Sept. 1977. 104 pp.

This report, part of a series on the northeast coal study, contains the first application of a form of visual unit analysis which had not been implemented previously in British Columbia. Visual landscape units are defined on the basis of a range of physiographic and vegetation criteria. Within one unit, zones are identified with different degrees of vulnerability to visual intrusion and other developmental impacts. See also: R. Horner, *Visual Resources of the Northeast Coal Study Area, 1977-1978*, in preparation, a sequel to Tetlow and Sheppard. The second report attempts to link visual unit analysis and the various biophysical land classifications (terrain, soils, vegetation) which are used in B.C. The objective is to produce interpretive legends for scenic quality and visual vulnerability at both the macro-regional scale (physiographic region, vegetation zone) and the micro-regional scale (terrain/soils unit, vegetation unit).

Tunnard, Christopher. *A World With a View: An Inquiry into the Nature of Scenic Values.* New York: Yale University Press, 1968. Hardcover, 193 pp. $15.00.

"A world with a view", to the author, is a world in which an aesthetic sensibility is allowed to assert itself, not only in the preservation of the past but also in the care we give to the development of the modern landscape. This book surveys this problem historically and articulates Tunnard's understanding of what must be done to create and maintain an aesthetic sensibility.

University of Guelph, Centre for Resources Development. *Location Hydro.* The Centre (Guelph, Ont. N1G 2W1), n.d. (about 1976). 166 pp.

This massive report, prepared for Ontario Hydro, was designed to provide information on how and where to locate overhead electric power transmission lines to minimize environmental impact. Handsomely presented in text, maps and illustrations, the report devotes the bulk of its attention to scenic resources (Chapter 3, "Visual Impacts and their Evaluation: Physical Design", pp. 30-124). The study develops an evaluation process for measuring the visual impact of OH lines, similarly formulates a comprehensive inventory process, integrates these two processes into a framework for locating OH lines to minimize visual impacts, works out appropriate locational criteria, and expresses all of the foregoing as a unified visual impact method. The study concludes that the visual impact of OH transmission lines could be significantly reduced by proper location and design based on an understanding of the visual relationship between a transmission line and the character of each landscape type.

U.S. Forest Service. *Forest Landscape Management. Vol. 1.* U.S. Dept. of Agriculture, Forest Service, Northern Region (La Grande, Oregon), Feb. 1972. 137 pp. *National Forest Landscape Management. Vol. 1.* Feb. 1973. 76 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $1.80 + 25% outside U.S.A. *National Forest Landscape Management: Utilities. Vol. 2.* July 1975. 147 pp. Available from U.S.G.P.O., $3.55 + 25% outside U.S.A.

Three volumes that address visual aspects of forest management with wider application to other forms of environmental planning and management. The 1972 volume discusses how we see visual resources (distinguishing between seeing and perceiving). It describes six landscape management alternatives: preservation, enhancement, retention, deterioration, destruction, and rehabilitation. Three topic areas – timber harvest, roads and structures – are examined in terms of visual effects analysis and landscape management techniques. The 1973 report defines basic concepts of landscape management (the planning and design of the visual aspects of multiple-use management) illustrated with examples from forests. The 1975 report aims at a mode of planning, design and of utilities that will visually harmonize them with or subordinate them to the landscape. Chapters deal with planning a utility system, visual characteristics of utilities, visual dominance elements and utilities, visual impacts on the landscape, examples of utility installations (gasline, electric transmission line, microwave systems and water-collection systems) and technical aspects of the foregoing utilities.

Wright, G., "Appraisal of Visual Landscape Qualities in a Region Selected for Accelerated Growth", *Landscape Planning*, Vol. 1, 1974, pp. 307-327.

Yeomans, W.C. *Landscape Architecture and the Visual Resource.* B.C. Environment and Land Use Committee Secretariat (Parliament Buildings, Victoria V8V 1X4), 1975. 28 pp.

This document, prepared for the provincial government, was intended to be an introductory manual of visual management concepts, principles and elements. U.S. Forest Service experience contributed strongly to the report.

Yeomans, W.C. *Spallumcheen: The Visual Environment – A Landscape Sensitivity Analysis.* B.C. Agricultural Land Commission (4333 Ledger Ave., Burnaby, B.C. V5G 3V2), n.d. 120 pp. Available from Queen's Printer, Province of British Columbia (Parliament Buildings, Victoria, B.C.), $10.00.

This study originated from concern, expressed by Spallumcheen municipality (southern interior of the province) to the B.C. Agricultural Land Commission in 1975, that encroaching urbanization might destroy the character of their rural environment. The study develops the Visual Resource Management System (adapted from the U.S. Forest Service) and presents a working model for community planning in harmony with the environment.

Zube, E., "Scenery as a Natural Resource: Implications of Public Policy and Problems of Definition, Description and Evaluation", *Landscape Architecture*, Vol. 63, 1973, pp. 126-232.

Zube, E., Brush, R.O. and Fabos, J.G. *Landscape Assessment: Values, Perceptions and Resources.* Stroudsburg, PA: Dowden, Hutchinson & Ross, 1975. Hardcover, 367 pp. $35.00.

This book contains 21 papers, comprising a state-of-the-art review of landscape assessment, organized around three major themes: values, perceptions and resources. The section on the former focuses on qualitative values associated with the landscape from the perspectives of history, humanism, design, conservation and economics. The section on perception emphasizes human responses to the visual landscape. The resources section deals with models developed for landscape planning and management including general approaches to landscape assessment and specific models related to the impact of highways and recreation on visual resources.

3.6 Environmentally Sensitive Areas

Certain lands and related resources at the local, regional, national and international scales are deemed especially significant, either because uncontrolled human activities are liable to degrade them and perhaps destroy the values they represent, or because they are hazardous to human life and property. Such areas have numerous labels – environmentally sensitive, critical, natural, remnant and so on – which reflect the difficulty in defining "sensitivity" (concerning the characteristics of the environmental resource) and "significance" (which reflects a value placed on it). Among the classifications that have been developed are the following:

1. *Fragile lands*: requiring protection from human activity. These include shorelines of oceans/lakes/streams, wetlands, rare geologic formations, irreplaceable woodland resources, certain wildlife habitats, nesting grounds or migratory stop-over points, and areas of rare or endangered flora and fauna. Recently some of these have blocked major construction projects; TVA's huge Tellico Dam Project on the Little Tennessee River was stopped when the sand darter, a 3 inch perch, was found to exist only in these waters.
2. *Hazard lands*: requiring man to be protected from the natural environment. Examples are floodplains, steep or unstable slopes, landslide-prone areas, and zones of high seismic or volcanic activities.
3. *Renewable resource areas*: where the natural environment needs to be protected from human activities in order to safeguard related human use. Included in this category are aquifer recharge zones (their "development" might end up polluting the water supply), prime agricultural land, mineral resource areas, forest lands, and areas particularly productive for fish and terrestrial wildlife.
4. *Cultural resources*: areas that require protection from man's use but, compared with (3), are less easily justified on economic grounds. This includes areas of outstanding scenic value, areas of particular scientific or educational value, certain recreational resources, and lands containing unique historic, archaeological and architectural resources.



Acknowledgements 3.6

This section includes contributions from:

Dirk Blyleven
David Brown
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Tom Farrell
Stewart Hamill
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Mary Smith
Brian Wilkes
Ken Whiteford
Phil Wood

The environmentally sensitive area approach is relatively easy for planners to accept because it is a land-use concept. But it poses certain procedural problems in practice:

Identification: establishing appropriate criteria to define "environmentally sensitive area" and to determine what falls inside and outside this classification. Criteria must be specific enough to be used in the field where boundaries have to be identified and resources inventoried, as well as being legally and politically defensible within the limits of available data, knowledge and time (short-term quick-and-dirty studies often miss rare and endangered species, for example).

Acquisition and/or regulation: acquiring all or part of the development rights to such areas and ensuring that their use is limited to activities compatible with their continued functioning and existence. Again, this must be done in ways that will stand up in court, in the political arena and at budget time. Municipalities are experimenting with performance standards, transfer of development rights and environmental analyses/ assessments in designated environmentally sensitive areas.

Management: ensuring the ongoing functioning of the valued natural system or feature (e.g. few woodlots can just be left alone). This involves having the capability to monitor changes (in the productivity of a marsh, for example) and to take necessary corrective measures.

One important consideration is to implement an *integrated* environmentally sensitive area program, not merely parts of one. Identifying ecologically unique areas, for example, may do more harm than good if people rush out to see them or speculators buy them up; the other elements of the ESA Program must also be ready to be put in place. This raises a further problem: municipalities often do not possess the necessary powers to acquire or regulate development in sensitive areas, outside of floodplains and public open space.

A final factor to consider is the interrelatedness of environmental sensitivity and significance at various scales, from local through to global. Co-operative and co-ordinative efforts are essential here.

Case Study 47
Warbler (Byron) Woods, London, Ontario
Submitted by Stewart Hilts, University of Western Ontario

The controversy over proposed development in this 150-acre rolling woodland on the edge of London illustrates the problem of defining "sensitive" as opposed to "significant". About a third of the wooded area is sensitive in the sense of hazardous, with steep slopes (over 15%), streams and seepage. An environmental study prepared for the developer designated 66 acres as open space. Several local groups, however, claim that the *entire* area is sensitive in the sense of significant.

The development will likely be held up for some time due to the resulting controversy. Elected representatives and the developer are ready to accept the "sensitive" argument but not the "significant" one even though (a) the latter is used by the Ontario Ministry of Natural Resources, and (b) recent studies have suggested that Warbler Woods is one of the four highest-quality natural areas in London and one of the six highest in Middlesex County.

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Case Study 48
An Approach to Environmentally Sensitive Areas

The Regional Municipality of Waterloo has adopted the following list of criteria for environmentally sensitive areas in its Official Plan:

a. The occurrence of significant, rare or endangered indigenous species within the designated area.

b. The identification of plant and/or animal associations and/or landforms that are unusual or of high quality regionally, provincially or nationally.

c. The classification of the area as one which is large and undisturbed, thereby potentially affording a sheltered habitat for species that are intolerant of human disturbance.

d. The classification of the area as one that is unique, with limited representation in the Region, or a small remnant of once-larger habitats that have virtually disappeared.

e. The classification of the area as one containing an unusual diversity of plant and animal communities due to a variety of geomorphological features, soils, water and microclimatic effects.

f. The identification of the area as one that provides a linking system of undisturbed forest for the movement of wildlife over a considerable distance.

g. The performance of the area in serving a vital ecological function, such as maintaining the hydrological balance over a wide area providing natural water storage or recharge.

h. The recognition of the area as one demonstrating any of the foregoing qualities but suffering reduction of its uniqueness or rareness by the intrusion of human activities.

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Case Study 49
ESA Program for Ottawa-Carleton
Submitted by Stewart Hamill, National Capital Commission

The Regional Municipality of Ottawa-Carleton (RMOC), as part of its official regional plan, initiated a program for environmentally sensitive areas called the River Corridors-Conservation Areas Project. With no biologist on staff and little knowledge of ESAs in the region, the RMOC in 1974 asked for input. The Ottawa Field Naturalists Club provided a hastily prepared list of areas with brief descriptions. The RMOC accepted this list and included it in its official plan, then hired a local professor to do an ecological inventory of these areas. RMOC planners revised the list and proposed a system of ESAs. The Conservation Committee of the Field Naturalists Club responded by providing additional information to support its original designations.

Meetings have been held to receive input from the public. Reaction has been strong and adverse. Owners of land designated for conservation feel that the value of their property will be decreased while conservationists argue for inclusion of areas which were not designated or were de-designated. The plan now awaits an Ontario Municipal Board decision.

Refer to the following documents, available from the Regional Municipality of Ottawa-Carleton (address below):

C. Billington, *Ecological Studies of Conservation-Recreation Areas in the Regional Municipality of Ottawa-Carleton*, Addendum to the Second Report (Sept. 1976), 1977.

R.M. Reed, *An Ecological Study of Conservation-Recreation Areas in the Regional Municipality of Ottawa-Carleton*, 1975, and R.M. Reed et al., *Ecological Studies of Conservation-Recreation Areas in the Regional Municipality of Ottawa-Carleton*, 1976.

R.M.O.C., *Conservation Lands in Ottawa-Carleton*, 1977 with *Technical Appendix* and 5 Background Papers. *Ottawa and Rideau Rivers and Shores in Ottawa-Carleton*, 1978.

Available from the Ottawa Field Naturalists Club (Box 3264, Postal Station C, Ottawa K1Y 5J6):

O.F.M.C., *The Ottawa Field Naturalists Club Proposal for the Retention of the South Gloucester (Blais Road) Conservation Area, 1978, and Response to the Conservation Lands Report of the Regional Municipality of Ottawa-Carleton*, 1978.

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Case Study 50
ESA Activity in P.E.I.

Prince Edward Island has formed a Natural Areas Advisory Committee to identify significant and sensitive natural areas in that province. The committee could be a useful contact for anyone working in this field, and would appreciate hearing from such practitioners.

Contact:
Daryl Guignon
Chairman
Natural Areas Advisory Committee
c/o Land Use Service Centre
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Charlottetown, P.E.I. C1A 7N8

ESA Activity in Southern Ontario

Groups in several counties and regions in southern Ontario have recently studied "environmentally sensitive" or "natural" areas and produced reports aimed at local planning officials. Research is ongoing in the London, Middlesex, Oxford, Grey, Manitoulin, Waterloo, Brent, Hamilton-Wentworth, Niagara, Peel, Halton, Toronto, York, Wellington, Northumberland and Ottawa-Carleton areas.

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Case Study 51
Environmentally Sensitive Areas in Two Municipal Plans
Submitted by Ken Whiteford, County of Perth

The County of Perth in southwestern Ontario has few environmentally sensitive areas due to substantial agricultural use of the land. Such areas that remain, therefore, are all the more important, for a variety of reasons including aesthetics and groundwater recharge/retention. To protect existing natural environment components still capable of being preserved, two recently completed Central Perth and North Perth Official Plans have included a "Natural Preservation" designation. It includes all land-water combinations that are biologically significant and fragile environments that are sensitive to develoment and other human use. Data from the International Biological Program and the provincial Ministry of Natural Resources were used to identify the ESAs; the County does not have such information on hand. Each plan sets out a number of policies especially applicable to ESA management.

It is too early to assess the effectiveness of this approach. Problems are anticipated with implementation of the policies, especially the application of development controls. Presumably ESAs will be subject to environmental assessment prior to any decision by planning boards and municipal councils concerning development proposals in or near these areas.

The approach used in Central and North Perth is applicable to other planning jurisdictions. But means will have to be found to overcome the problems associated with lack of data for ESA identification and with implementation if rural municipalities with small planning operations are to move beyond the initial step of designation.

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Information Resources

See also:
2.3 Water Quality
2.5 Vegetation
2.6 Wildlife and Fish
5.2 Information
5.4 Plans

Allen, P.F.L., Gates, C., and Thompson, J.P. *An Account of Natural Area Programmes: Implications for Ontario.* York University, Faculty of Environmental Studies (4700 Keele St., Downsview, Ont. M3J 2R2), May 1976. 135 pp. Unpublished; check with Resources Centre.

This study, by three graduate students, includes a discussion of natural area concepts, international programs aimed at conservation, provincial policies towards natural areas across Canada, and implications for Ontario.

Billington, C. and Tozer, E.W. *Ecological Inventory of NCC Urban Corridors.* National Capital Commission (48 Rideau St., Ottawa K1N 8K5), Aug. 1977. 101 pp.

The Regional Municipality of Ottawa-Carleton proposes to use, for bus transit purposes, certain linear corridors acquired by NCC for its parkway system. Some corridors contain environmentally sensitive areas with significant plant species, plant associations and urban wildlife habitats. This report, prepared by the NCC's Interpretation and Conservation Section, provides information and places priorities on ecological resources in the corridors. However, ecological considerations do not seem to be receiving adequate consideration in decisions concerning use of the corridors. See also Case Study 49.

Burton, Ian, Kates, Robert F. and White, Gilbert F. *The Environment as Hazard.* New York: Oxford University Press, 1978. Paperback, 240 pp. $5.95.

This book first examines whether human activities are increasing the types and extent of environmental hazard (flooding, drought, cyclones, earthquakes, etc.). The authors conclude that the natural environment is indeed becoming more hazardous in complex ways that defy easy reversal. The concept of "hazard" is then defined and the patterns of human response – ways in which people make choices and cope with extreme events – are described with examples from around the world. The process of human occupation of hazardous areas is examined from individual and collective perspectives. National policy to foster or prevent certain actions by individuals and groups is investigated, as well as international action. The book concludes by re-examining natural extremes and social resilience.

Canadian Institute of Forestry, "Canadian Institute of Forestry Policy for Selection, Protection and Management of Natural Areas", *Forestry Chronicle*, Vol. 48, No. 1, 1972, pp. 1-3.

Conservation Council of Ontario. *Natural Areas Bylaw. Discussion Draft.* CCO (45 Charles St. E., Toronto M4Y 1S2), n.d. 4 pp.

The Council has been working with a number of individuals and groups, including the Canadian Environmental Law Association, to formulate a prototype municipal bylaw for the designation, protection and management of locally significant natural areas in Ontario.

Council of State Governments. *State of the Art for Designation of Areas of Critical Environmental Concern.* Council of State Governments (Iron Works Pike, Lexington, KY 40511), Dec. 1974. 52 pp. $2.00.

Provides a definition of areas of critical environmental concern, briefly discusses the state-of-the-art in planning for such areas and reviews selected state programs (Florida, Wisconsin, New York and California).

Dasmann, R.F., "Towards a System for Classifying Natural Regions of the World and their Representation by National Parks and Reserves", *Biological Conservation*, July 1973, pp. 114-117.

Federation of Ontario Naturalists. *Nature Reserves Manual.* FON (1262 Don Mills Road, Don Mills, Ont. M3B 2W7), 1971. $1.00.

Francis, G.R. and Eagles, P.F.J. (eds.). *Environmentally Sensitive Areas Study.* Regional Municipality of Waterloo (Marsland Centre, Waterloo, Ont. N2J 4G7), 1975. 99 pp.

In 1974 the Regional Municipality of Waterloo designated about 70 remnant natural areas as environmentally sensitive as part of the preparation of an environmental policy for the Regional Official Policies Plan. This study builds on that work in three ways: by providing more information on some of the areas (verified in the field); by developing a computerized system for recording data on the Region's flora for comparison with data from the areas designated as environmentally sensitive, and by reviewing the existing legislative framework in Ontario for its effect on the protection and management of environmentally sensitive areas. See also: G.R. Francis, "Pieces of Green: A Regional Policy to Protect Remnant Natural Areas", *Ontario Naturalist*, Oct. 1977; and Parsons, below, which includes Francis' paper, "Some Perspectives on Conserving a System of Remnant Natural Areas in Southern Ontario".

Franson, R. *The Legal Aspects of Ecological Reserve Creation and Management in Canada.* International Union for Conservation and Natural Resources (1110 Morges, Switzerland), IUCN Environmental Policy and Law Paper No. 9, 1975.

Gelback, F.R., "Investigation, Evaluation and Priority Ranking of Natural Areas", *Biological Conservation*, Vol. 8, 1976, pp. 79-88.

Kirk, Malcolm. *Techniques for the Preservation of Natural Areas.* Outdoor Art and Science School (375 Edinburgh Rd. S., Guelph, Ont. N1G 2K7), 1978. 38 pp. $2.50.

Discusses the definition of a natural area, organizing a natural area survey and managing natural areas. Nine Ontario case histories are presented briefly. The report then examines the handling of an issue, provincial responsibilities, environmental assessment and the Ontario Heritage Foundation. Appendices include a list of environmental organizations in Ontario, ESA policy guidelines, a "Life Science Inventory Checklist" and an article, "Wetlands Down the Drain".

Krajina, V.J. et al. *Ecological Reserves in British Columbia.* Canadian Committee for the International Biological Programme, 1974.

In response to vanishing unique and representative landscapes, a group of biologists in British Columbia began lobbying the provincial government in 1968 for the establishment of a system of ecological reserves (areas for scientific and resource management research, landscapes large enough to maintain wild gene pools of different species, samples of native flora and fauna for comparison with actively managed areas, outdoor learning resources). The Ecological Reserves Act, passed in 1971, reserves Crown land parcels for the above purposes. By 1974, 55 reserves with a combined area of 364 km² had been established by Order in Council; although their protection is not absolutely guaranteed, this Crown land has been the least touchable by resource industries. The ecological reserves program, including detailed selection criteria and references, is described by the above report. Contact the National Research Council, Associate Committee on Ecological Reserves (address under NRC).

Lang, Reg and Armour, Audrey. *Municipal Planning and The Natural Environment.* Toronto: Ontario Planning Act Review Committee, 1977. 90 pp. Available from Ontario Government Bookstore (880 Bay Street, Toronto M7A 1N8), $1.25, cheque payable to Treasurer of Ontario.

This report, which examines the natural-environment component in Ontario official (municipal development) plans, found the use of environmentally sensitive areas to be increasingly common at the level, although the emphasis is heavily on hazard lands. It recommends (pages 52-55) new legislation to allow municipalities to create "Environmental Protection Areas", favoured over the more ambiguous "environmentally sensitive areas". Annotated further in 1.3 Characteristics of Environmental Planning.

Man and Biosphere Program. *Task Force on Criteria and Guidelines for the Selection of Biosphere Reserves in Canada.* MAB (Environment Canada, Ottawa K1A 0H3), 1974.

Mosquin, T. and Suchal, C. (eds.). *Canada's Threatened Species and Habitats.* Canadian Nature Federation (203-75 Albert St., Ottawa K1P 6G1), 1976. 185 pp. $8.00.

Proceedings of the Symposium on Canada's Threatened Species and Habitats, Ottawa, 20-24 May 1976. A collection of 38 short papers including three on the protection of natural habitats.

National Research Council, Associate Committee on Ecological Reserves. *Newsletter*, Nov. 1977. Available from the Committee (Montreal Road, Ottawa KIA OR6), Cyril D. Doucet, Secretary.

The Newsletter's purpose is to disseminate information on the status of ecological reserves in each of Canada's 10 regions – carrying on the work of the Conservation of Terrestrial Communities Subcommittee of the International Biological Programme – and to report progress and frustrations experienced in establishing such reserves. The November 1977 issue consists of the Associate Committee's 1976-77 annual report together with a brief report from each region. The Committee has also published *Canadian National Directory of IBP Areas, Second Edition, 1968-75*, 1977.

Natural Hazards Research and Application Information Center. *Computerized Information Retrieval Services Containing Natural Hazards Literature.* The Center (University of Colorado, Institute of Behavioural Science, Boulder, CO 80309), n.d. 7 pp.

Describes a number of computerized indices which list sources on natural hazards. One of the Centre's various activities.

Nepean, Township of. *Jock River Corridor – Technical Report and Discussion Paper.* The Township (3825 Richmond Road, Ottawa K2H 5C2), 1976. 82 pp.

Rapid urban development is putting pressure on the environmental resources of the Jock River Valley, near Ottawa. Nepean's Official Plan states that the Township's policy is "to obtain open shoreline wherever feasible and desirable for public purposes and to retain the overall rural and/or open space character of the lands". This study was to determine measures necessary for conserving amenity resources of the Jock River corridor, to examine its ecological characteristics, to ascertain its recreational potential, and to integrate corridor planning with other relevant planning in the municipality. The report provides necessary background information, then gives analysis results and conclusions with respect to water quality and quantity, land conservation, recreation and implementation.

Nettleship, David and Smith, Pauline. *Ecological Sites in Northern Canada.* Available from Federation of Ontario Naturalists Bookshop (8-10, 75 Albert St., Ottawa K1P 1G6), 1975. Paperback, $3.75.

A listing of 71 biologically important areas designed to assist in land-use planning in the Arctic.

Ontario Ministry of Natural Resources. *Environmental Protection Areas.* Dec. 1963. *Hazard Lands.* June 1975. MNR (99 Wellesley St. W., Toronto M7A 1W3)

Two papers that describe the Ministry's approach to environmental protection areas and (as a subset) hazard lands. Highly influential with municipalities.

Parson, Helen E. (ed.). *Natural Areas: Identification, Dedication and Management and Student Symposium on Natural Area Studies.* Wilfrid Laurier University, Dept. of Geography (Waterloo, Ont. N2L 3C5), 1978. Paperbach, 90 pp. $2.00.

A special publication in the Geographical Inter-University Resource Management Seminar series containing papers from the March 1978 seminar and associated student symposium. The volume includes abstracts of current Ontario-oriented research of nine students (sensitive areas concept, national landmark preservation, land resource planning on the Oak Ridges Moraine, Delphi approach to planning natural areas, identifying vegetation communities, evaluating natural areas in the Don Valley, natural areas in London, Regional Waterloo's ESA program, and natural area preservation in Grey and Bruce Counties). Also the key address, "Some Perspectives on Conserving a System of Remnant Natural Areas in Southern Ontario" a critique of it, and a paper on political aspects of natural area conservation.

P.E.I. Provincial Planning Division, Land Use Service Centre. *Offshore Islands Study.* The Centre (P.O. Box 2000, Charlottetown, P.E.I. C1A 7N8), June 1977. 36 pp. and app.

This study was carried out in response to increased public concern over the future of Prince Edward Island's offshore islands. Extensive primary research led to the rating of each island according to its "sensitivity" to development (from extremely high, such as an island largely composed of wetlands and representing a significant nesting area for waterfowl, through a five-category scale to extremely low) and its "development potential" (for agriculture, forestry, housing/cottage and outdoor recreation). Specific management recommendations are made for each island.

Priddle, George B. (ed.), "Canadian Wildland Resources: The Role and Management of Wildlands as a Natural Resource", *Contact* (University of Waterloo, Faculty of Environmental Studies), Vol. 10, No. 1, Spring 1978.

Special issue on wildland resources. Articles, all Canada-oriented, deal with: the meaning of wilderness; wildlands; carrying capacity standards for wildland areas; wildland policy formation; legal tools for protecting privately owned wilderness areas; the wilderness controversy in Ontario; Regional Municipality of Waterloo's policy for remnant natural areas and wildland education.

Regional Municipality of Halton, Planning Dept. *Environmentally Sensitive Area Study.* The Department (1151 Bronte Road, Oakville, Ont. L6J 4Z3), 1978. 261 pp. $15.00.

Extensive study of the ESAs within the Region. The report outlines the process of ESA identification, including performance criteria used and interpretation; overviews the municipality's ESA policy; describes the environment of the region; and documents in detail each of the 38 ESAs.

Regional Open Space Task Force. *Areas of Critical Environmental Concern.* Association of Bay Area Governments (Hotel Claremont, Berkeley, CA 94705), June 1975. 83 pp.

Contains review criteria for land and water areas of regional significance. The criteria are designed to guide local governments in identifying these areas and to assist regional planners in reviewing plans and projects. Critical areas are broadly defined to include: lands for resource production; lands for resource preservation; lands for public safety; regional recreation and parks; scenic resources and the regional landscape; and sites of historic and cultural value.

Reed, Ian. *Land in Demand: The Niagara Escarpment.* Book Society of Canada Ltd. (Box 200, Agincourt, Ont. M1S 3B6), 1977. Paperback, $3.00.

The book, intended for use by students at various levels, describes this unique feature that crosses southwestern Ontario from the tip of the Bruce Peninsula to Niagara Falls. The resource of the Escarpment, land use conflicts along it and government's role in resolving these conflicts are discussed (see Niagara Escarpment Commission, referenced in 5.4 Plans). During preparation of its Draft Plan, the Commission (232 Guelph St., Georgetown, Ont. LTG 4B1) made extensive studies of environmentally sensitive areas within its Planning Area.

Sherrington, Peter (ed.). *Calgary's Natural Areas: A Popular Guide.* Calgary Field Naturalists Society (P.O. Box 981, Calgary T2P 2R4), 1975. Paperback, 184 pp. $3.75.

A centennial project demonstrating what a local group can do to document the city's "natural treasures", probably unknown to most of its residents.

Smithsonian Institution. *Planning Considerations for Statewide Inventories of Critical Environmental Areas: A Reference Guide.* Washington, DC: U.S. Dept. of the Army, 1974. 274 pp. Available from National Technical Information Service (5285 Port Royal Rd, Springfield, VA 22161), NTIS No. 622451515 C, $6.50.

This report identifies major issues to be considered in planning, carrying out and implementing a statewide inventory of critical environmental areas (defined as areas where uncontrolled or incompatible development could result in damage to the environment, life or property, or the long-term public interest, which is of more than local significance, including natural hazard lands, fragile or historic lands, renewable resource lands, and additional areas deemed by the State to be of critical environmental concern). Extensive appendices list sources of information on resource inventories, rating and capability classification schemes, critical area programs, etc.

Stover, Emily J. *Protecting Nature's Estate: Techniques for Saving Land.* Washington, DC: U.S. Dept. of the Interior, 1976. 122 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 024-016-00082-0, $3.25 + 25% outside U.S.A.

This report discusses identifying "resource areas" for protection, the politics and economics of land protection, and conservation tactics and protection approaches (states and local master planning technique, private approaches to saving land, regulating growth, environmental review, transfer of development rights, making gifts of land to nature conservancies, etc.) with many examples and mini case studies.

Swaigen, John, "Legal Tools for Protecting Privately Owned Wilderness Areas", *Contact* (University of Waterloo), Vol. 10, No. 1, 1978, pp. 106-116.

The author is legal counsel for the Canadian Environmental Law Association.

Thurow, C., Toner, W. and Erley, D. *Performance Controls for Sensitive Lands: A Practical Guide for Local Administrators, Parts 1 and 2.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), 1975. Paperback, 156 pp. $12.00.

The report discusses environmental protection and management approaches to streams and creeks, aquifers, wetlands, woodlands and hillsides, and provides examples of U.S. municipal ordinances for erosion and runoff. Environmentally sensitive areas are defined as land areas whose destruction or disturbance will immediately affect the life of a (human) community by either (a) creating hazards such as flooding and landslides, (b) destroying important public resources such as water supplies and the water quality of lakes and rivers, or (c) wasting important productive lands and renewable resources.

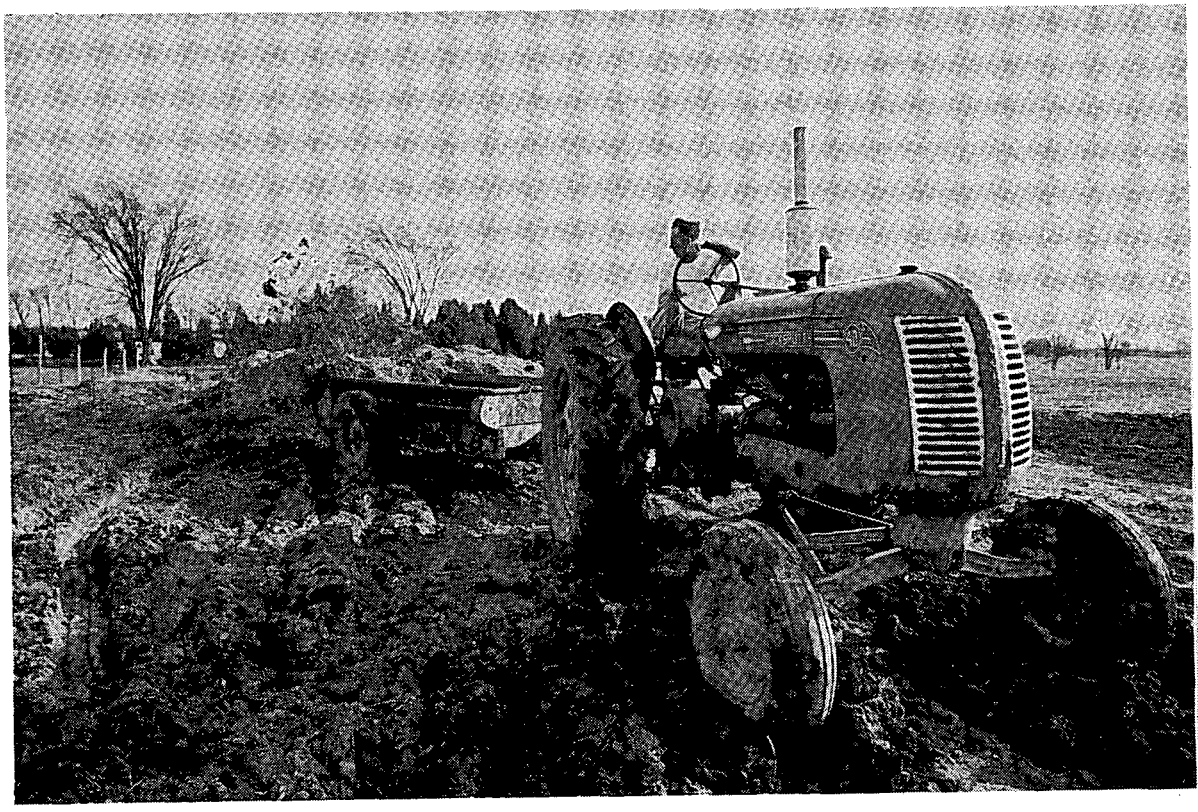
3.7 The Rural-Urban Fringe

Urban and rural meet in a zone of transition and interaction. People, resources, money, goods, information and ideas move back and forth between urban and rural areas. The result is more than just a zone awaiting urbanization. The evidence (e.g. results of study by Punter) suggests that a human ecosystem and lifestyle, distinctive in socio-economic and landscape terms, may exist in the rural-urban fringe. But often the interface is also the scene of strong development pressures accompanied by economic and environmental conflicts. Furthermore, as Troughton notes, "The cultural environment in the rural-urban fringe is, if anything, under greater stress than other elements". Of all the human ecosystems of Canada, the rural-urban fringe is the one in which the greatest degree of change is occurring in political terms, and where the most obvious problems exist between the

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This section includes contributions from:

George Atamanenko
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Lorne Sully
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form of existing structures and the requirements of a political framework."

The existence of a rural-urban fringe is to be expected where urban areas grow and expand in the absence of stringent controls to distinguish them clearly from the countryside (as in some European countries). Land in the town or city increases in value, taxes go up, housing becomes more expensive – such push factors will cause various people to look farther out for a place to live, aided by easy mobility and a typical under-rating of commuting costs. The pull factor may be stronger than ecomomics, however; many people simply prefer to live in the country. The resulting fringe development is accelerated by competition for land.

Problems can and usually arise if patterns of rural nonfarm development are allowed to be haphazard, disorderly and discontinous. Land-based resources are then wasted, usually at considerable, initially hidden cost; land use conflicts occur. Demands for urban services arise and these are often provided even though expensive. Natural systems are stressed often to the point of complete transformation, usually to simpler systems. And environmental quality suffers, especially the countryside's amenity resources. The cycle, which tends to repeat itself farther out, is a familiar one in most parts of Canada. The problems it raises, largely the unintended by-products of many individual decisions, seem to be on the increase. This trend promises to continue. The Science Council of Canada points out that if, as seems likely, industrial and other demands for fossil fuels increasingly compete with agricultural demand, the energy cost-component of farm operations will continue to increase and marginal land will become economically even more marginal.

Rural urban-fringe problems are formidable, partly because of the institutional complexity involved, partly due to the implied interference with some basic rights (e.g. to own and enjoy property) and in part because many Canadians retain a strong yearning for the individualistic country life. Especially problematic are the *conflicts between urbanization and agriculture.* Over half of Canada's Class 1 agricultural land, nearly a third of the Class 2 and a fifth of the Class 3, is located within an 80 km radius of Canadian Census Metropolitan Areas (Manning and McCuaig). Close proximity of urban settlement and agriculture, once an acceptable and even necessary condition, now presents a fundamental threat to agriculture. During the period 1966 to 1971 Canadian cities consumed 100 acres of rural land every day; 200 000 rural acres, including 134 000 of Canada's most productive farmland, were paved in those five years (Gierman). Rural-urban conversion is especially threatening in southern Ontario and the St. Lawrence Lowlands which together contain over half of Canada's Class 1 land. But direct-conversion statistics can be misleading. A recent study by the Bureau of Municipal Research concluded that the means reason for the best foodlands going out of production in Ontario not urban development; it is rural nonfarm use - the gentleman/lady farmer, the urban couple seeking to escape city life, the gravel pit operator, the multitude of utilities looking for cheap land. In the Maritimes these problems are compounded by the pattern of land tenure, characterized by deep lots with small frontages; indiscriminate strip development then has the additional effect of alienating backland from either farm or nonfarm use.

Another factor at work is the *urban shadow.* In some parts of Canada pressure for removal of land from agricultural use extends far beyond the more easily observed rural-urban fringe. Land speculation and accelerating land values are particularly evident; around many urban centres land held by speculators exceeds their projected growth (Chung). Where urban-generated demands for farmland have raised its price to urban levels, farmers can either sell out, perhaps to invest elsewhere, or intensify production which in turn may lead to conflicts with nonfarm neighbours. Pressure to convert farmland may be augmented by assessment practices (though at least one province, Nova Scotia seems to have overcome this problem). Meanwhile, urbanization can have other detrimental effects on adjoining farm operations. Crop damage and reduction in yield are likely consequences of urban-generated air pollutants such as ozone, hydrogen fluoride, sulfur dioxide, acid rain and peroxyacetal nitrate (PAN). Market gardening, which tends to occur near big cities, is particularly susceptible.

Environmental conflicts similarly occur in the rural-urban fringe with respect to activities such as aggregate extraction (see 4.4 Resource Development), recreation and tourism (4.6) and urban waste disposal (4.3) which particularly affect visual resources, wildlife habitat, vegetation and water resource management. Protecting the

land base is only a partial solution. Preserving farmland does not guarantee its use for food production or preserve the agricultural community, but it is a necessary first step (Bureau of Municipal Research). Opportunities exist: to safeguard the land base against careless urban encroachment (among other things this means avoiding over-zoning and over-provision of sewerage and water services); to conduct land planning with careful detailed attention to compatibility among uses and to separate incompatible uses by adequate buffers; to encourage farmers to take a more ecologically oriented approach to agriculture; to encourage the continual agricultural use of land in areas not immediately slated for urban development (Ontario is doing this in its new community of North Pickering); to monitor closely the capacity and quality of environmental systems; and to minimize the environmental impacts of key urban, industrial and transportation activities in the rural-urban fringe.

Underlying all this is the need to expand planning horizons to encompass both sides of the rural-urban interface, within an ecosystem-biosphere concept.

Case Study 52
Regional Country Residential Survey, Saskatoon
Submitted by Lorne Sully, Saskatchewan Municipal Affairs

The "commutershed" of Saskatoon, approximately a 55 km radius, is a patchwork of good and poor farmland. The South Saskatchewan River valley, sand hills and tree cover, however, make the area attractive for "country living". Environmental problems in the area include scattered urban uses, misallocation of farm land, servicing inefficiencies, waste management and cultural intrusion.

Department of Municipal Affairs planning staff in Saskatoon, assisting local municipalities, undertook a survey of owners of rural nonfarm holdings in the five rural municipalities surrounding Saskatoon to determine attitudes and values held by country residents and the extent to which these values influenced their locational decisions. Response was good. Results showed that roadway accessibility and a good water supply are dominant site-attractiveness factors, along with maintenance of roadways and direct costs. Most residents, when seeking property, considered the desired density (and therefore, indirectly, the parcel size) and succeeded in finding appropriate sites. A practical country residential lot size of five to ten acres was most often mentioned as ample and manageable space for many desired uses. Peace and quiet, privacy, space, natural setting and freedom were popular reasons for deciding to locate in the country.

The results of the survey are being used in the rewriting of local bylaws and as input to the three regional planning studies now underway.

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Case Study 53
Urban-Rural Conflict: The Glengowan Dam near London
Submitted by Ken Whiteford, County of Perth

In 1952 a report for the Upper Thames River Conservation Authority proposed construction of the Glengowan Dam at the confluence of the Thames and Avon Rivers to protect the Town of St. Mary's and downstream community against flooding. The proposal remained low priority until 1975 when the Thames River Basin Management Study recommended it be built but primarily for a new purpose: low-flow augmentation to provide sufficient dilution of sewage from the City of London during summer months. The dam would flood 1 276 acres, much of it prime agricultural land, in the Township of Fullarton; concern was also expressed over displacement of 16 families including an entire hamlet, tax loss to the Township, depreciation of the area's aesthetic quality, and the lack of secondary benefits (such as recreation) from the reservoir. The dam proposal resulted in formation of the Organization for the Protection of the Upper Thames by farmers in the Township. After concerted efforts by OPUT in 1977, the Ministry of Natural Resources announced in January 1978 that the dam would be subjected to an environmental assessment under the Environmental Assessment Act.

The Glengowan Dam Case presents an interesting interaction between urban and rural interests. Construction of the dam, closely related to London's future growth, is supported by the

City and Town of St. Mary's. The City of Stratford and several rural municipalities in the County of Perth are totally opposed to it, however. The project raises a familiar problem; the major benefits would go to people some distance away while those within the immediate impact zone would bear almost all of the adverse effects.

Refer to:
Ontario Ministry of the Environment and Ministry of Natural Resources, *Thames River Basin Water Management Study*, Ministry of the Environment (135 St. Clair Ave. W., Toronto M4V 1P5). For a social/environmental perspective of the proposed dam, see: Carl Griffith, "Social Impact Assessment: The Proposed Glengowan Dam", *Social Impact Assessment*, 30 June/July 1978, pp. 4-12 (available on a subscription basis, $5.00 a year for individuals, 12 issues a year, from C.P. Wolf, Environmental Psychology Program, CUNY Graduate Centre, 33 W. 42 St., New York, NY 10036.)

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Information Resources

See also:
2.1 Land Use and Misuse
4.1 Agriculture
4.2 Urbanization

B.C. Ministry of Agriculture, Green Zone Committee. *Let's Be Good Neighbours*. The Committee (Abbotsford, B.C. V2S 1X4), 1977.

A brochure that proposes alternatives to severe restrictions on intensive agricultural operations using a "minimum distance program". See also the detailed report: Green Zone Committee, *Agricultural Zoning and Waste Management*, 1977, 51 pp.

Beaubien, Charles and Tabacnik, Ruth. *People and Agricultural Land*. Ottawa: Science Council of Canada, Perception 4, Study on Population, Technology and Resources, June 1977. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $4.00.

Focuses on the problem of agricultural land loss due directly or indirectly to development. The review of the key issues is comprehensive, providing an up-to-date introduction to this complex problem. Parts of the report deal with land planning for agriculture, land regulation and the rights/obligations of ownership, dynamics of the urban fringe, land speculation, and reforming urban development with agriculture in mind. The conclusion deals with recommendations and possible directions for protecting Canada's agricultural land base.

Bureau of Municipal Research. *Food for the Cities: Disappearing Farmland and Provincial Policy*. BMR (2 Toronto St., Suite 306, Toronto M5C 2B6), June 1977. 94 pp. $4.00.

Southern Ontario farmland, according to the Science Council of Canada, is in greater jeopardy than anywhere else in Canada. This problem is addressed here by a collection of papers presented at the BMR-sponsored Food for the Cities Conference in Toronto, March 1977. In its background paper, "Disappearing Farmland: So What?" the Bureau identifies several causes: urban expansion, the economics of farming and rural nonfarm development. Although the popular news media give it a great deal of attention, the direct expansion of cities and towns is not a significant part of the farmland withdrawal problem. The Bureau concludes that nonfarm uses of rural land now are the predominant influence in farmland withdrawal. Factors underlying nonfarm demands for rural land include the overall requirements of the economic system (land for highways, utility corridors, aggregate extraction, etc.), increased use of the countryside as an interlude to or escape from city life, speculative investment in land, and the purchase of land by individuals as a hedge against inflation. A complicating factor is the existence of a land use planning system that is almost totally urban-oriented, ignoring the needs of the countryside. Nonfarm demands for land are a problem not just because they use up land directly but also because they set in motion a process of deteriorating conditions for agriculture (demands for urban-level services, farm-nonfarm conflicts, fragmentation of the land base and support services, inflationary pressure on land prices, and eventual destruction of the agricultural community). The long-range implications of farmland withdrawal in southern Ontario are serious. The provincial government's response, *Food Land Guidelines*, is judged inadequate to ensure that Ontario's better farming areas are

kept for agricultural purposes. (The Guidelines are only suggestions designed to assist municipalities in their planning; contrast his approach with British Columbia's and recent proposals by the Québec government). The BMR recommends a land policy for agriculture that would require municipal designation of permanent agricultural reserves, commit the Province to tougher restrictions on land use changes, and apply a joint provincial-municipal planning process.

Chung, J.H. *Land Market and Land Speculation.* Central Mortgage and Housing Corporation (Head Office, Montreal Road, Ottawa K1A 0P7), 1969.

Clawson, Marion. *Suburban Land Conversion in the United States: An Economic and Government Process.* Baltimore: Johns Hopkins Press, 1971.

Friedmann, John and Miller, J., "The Urban Field", *Journal of the American Institute of Planners*, Vol. 31, 1965, pp. 312-319.

Gertler, Len and Crowley, Ron. *Changing Canadian Cities: The Next 25 Years.* Toronto: McClelland and Stewart, 1977. Paperback, 474 pp. $8.95.

Chapter 6, "The Urban Surroundings", deals with urban fringe/shadow/field including (briefly) the natural environment.

Gierman, D.M. *Rural to Urban Land Conversion.* Occ. Paper No. 16, Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1977. 74 pp. Free.

Gray, E.G., "Direct Urban Land Needs in the Decade Ahead", *Notes on Agriculture*, July 1972, Vol. 8, No. 3, pp. 20-21.

Hodge, Gerald, "The City in the Periphery", in Bourne, Larry et al (eds.). *Urban Futures for Central Canada: Perspectives on Forecasting Urban Growth and Form.* Toronto: University of Toronto Press, 1974.

Krueger, Ralph R., "The Destruction of a Unique Renewable Resource: The Case of the Niagara Fruit Belt", in Krueger, Ralph R. and Mitchell, Bruce (eds.). *Mananaging Canada's Renewable Resources.* Toronto: Methuen, 1977. Paperback, 333 pp. $9.95.

Lassey, William R. *Planning in Rural Environments.* New York: McGraw-Hill, 1977. Hardcover, 257 pp. $13.95.

Annotated in 1.3 Characteristics of Environmental Planning. Particular emphasis is given to social aspects of rural planning and development.

Lewis, Wendy Simpson. *Windsor-Quebec Axis Map.* Dept. of Energy, Mines and Resources, Canada Map Office (615 Booth St., Ottawa K1A 0E9), Map ELD-3, 1974. $3.00 from authorized map dealers (write the Office for a list).

This 47' X 67' colour map illustrates the impact of urbanization on land in the region between Windsor and Quebec City. The 11 insets present data on loss of farmland, land capability for agriculture, land dynamics and land use changes in the Toronto urban fringe, urban growth in Ottawa-Hull, changes in Montreal's central business district, outdoor recreation opportunities, population changes and population density. See also Yeates.

MacLaren, James F. Ltd. *Countryside Planning: A Methodology and Policies for Huron County and the Province of Ontario.* Toronto: Ministry of Treasury, Economics and Intergovernmental Affairs, July 1975. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $3.00, cheque payable to Treasurer of Ontario.

This study is aimed at developing a planning method for rural areas. A case-study approach was used, based on the agricultural Huron County in southwestern Ontario. The devised method attempted to establish an overall viewpoint or "perspective" on a given area's present and future dominant function (e.g. agriculture, recreation, urban, forestry, mineral). Functional, resource-use and socio-economic factors define the perspective which, in a policy sense, represents a clearly stated long-term bias toward that function. Supportive and conflicting uses are identified. Environmental considerations are a kind of overlay on all perspectives. For application of this approach see: Northumberland Area Consulting Group, *Northumberland Task Force Development Strategy*, County of Northumberland (860 William St., Cobourg, Ont.), Dec. 1975.

Manning, E.W. and McCuaig, J.D. *Agricultural Land and Urban Centres: An Overview of the Significance of Urban Centres to Canada's Quality Agricultural Land.* C.L.I. Report No. 11, Environment Canada, Lands Directorate (Ottawa K1A 0E7), July 1977. Free.

McKeague, Alex, "Inventory of Canada's Land Resource", *Agrologist*, Sept. 1975, Vol. 4 (4), pp. 10-13.

Ontario Ministry of Treasury, Economics and Intergovernmental Affairs. *Parkway Belt Final Report.* Toronto: TEIGA, 1978. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $6.00, cheque payable to Treasurer of Ontario.

Latest report in a series on the Province's attempt to create a "parkway" defining urban development along the lakeshore in the Toronto-Central Region and acting as a utility corridor. The second effort appears more successful than the first.

Pearson, N., "Preserving Canadian Farmland", *Queen's Quarterly*, Winter 1974, Vol. 81 (4), pp. 598-604.

Pearson, R.G. et al, "PAN-Type Injury to Tomato Crops in Southwestern Ontario", *Plant Disease Reporter*, December 1974, Vol. 58 (12), pp. 1105-1108.

Punter, J. *The Impact of Exurban Development on Land and Landscape in the Toronto-Central Region 1954-1971.* Central Mortgage and Housing Corporation (Head Office, Montreal Road, Ottawa K1A 0P7), 1974.

Rawson, Mary, *Ill Fares the Land.* Ministry of State for Urban Affairs, (Ottawa K1A 0P6), Urban Prospects Report, 1976. Free.

The report provides an overview of the approach taken by the British Columbia Land Commission to protect agricultural lands. Using Canada Land Inventory information, B.C. regional districts were required to prepare "Agricultural Land Reserve Plans". The general rule used by the Commission was that all Class 1, 2, 3 and 4 land would be put in the Agricultural Land Reserve Class. The report discusses application of this general rule and the kinds of adjustments made in response to it.

Rodd, S., "Remarkable Changes in the Rural Land Market", *Notes on Agriculture*, July 1972, Vol. 8, No. 3, pp. 21-22.

Russworm, Lorne, H. *The Urban Fringe in Canada: Problems, Research Needs, Policy Implications.* Ministry of State for Urban Affairs (Ottawa K1A 0P6), Feb. 1974. 93 pp.

Urban fringe is defined as the landscape adjacent to urban places of all sizes, usually the zone of future urban expansion presently making a transition to that state (cf. Troughton, below). Distinctions are made between the suburban zone, commuting zone, urban fringe and urban shadow - all subsumed in "the urban field or life-space of the city" and sometimes related to urban corridors (e.g., Quebec City to Windsor).

The urban fringe is examined using a matrix that identifies 13 major activities (residential, commercial, industrial, resource extraction, recreation, etc.) according to use, property and purpose set out against location and resources (amenity, physical and biological). The study looks closely at why cities have urban fringes. It then identifies and discusses a series of urban fringe problem categories: haphazard, scattered and conflicting land use activities; services and taxation; governmental, planning and administrative difficulties; land speculation, fragmentation and value; environmental impact; impact on agriculture; social problems; and impact on surrounding settlement. Eleven pages of references are appended.

Sargent, Frederic O. *Rural Environmental Planning.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), 1976. Paperback, 199 pp. $7.00.

Annotated in 1.3 Characteristics of Environmental Planning.

Sask. Dept. of the Environment and Dept. of Municipal Affairs. *Urban Fringe Development Problems.* Queen's Printer (Legislative Bldg., Regina, Sask.), 1973.

Science Council of Canada. *Population, Technology and Resources*, Report No. 25, July 1976. 91 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $2.50.

Urban policy and agricultural land use are covered on pages 37-48.

Soil Conservation Society of America, Ontario Chapter. *Crisis in the Countryside.* SCSA, 1976. 164 pp. Available from T.M. Kuntz (38 Wildrose Crescent, Thornhill, Ont.), $2.00.

Papers dealing with food-land preservation were presented by representatives of farm organizations, government, academia and politics.

Troughton, Michael J., "The Rural-Urban Fringe: Land Use Characteristics and Resource Management Challenges", *Urban Forum*, Vol. 3, No. 5, Jan.-Feb. 1978, pp. 8-13, 27.

The author, in the Department of Geography at the University of Western Ontario, argues for re-establishment of "the concept of the rural-urban fringe as a system which represents the process of urbanization and the response in terms of rural transformation or adaptation". He rejects the narrower concept of "the urban fringe" which emphasizes urbanization forces, thereby overlooking rural transformation and response, and which sees the fringe as an extension of the urban centre rather than as a distinct human ecosystem. Various studies of the rural-urban fringe associated with metropolitan Toronto are referenced.

Troughton, M.J., Nelson, J.G. and Brumm, S. (eds.) *The Countryside in Ontario*. University of Western Ontario, Dept. of Geography (London, Ont. N6C 4C4), n.d. Paperback, 260 pp. $6.00.

Proceedings of the Countryside in Ontario Conference, April 1974. Papers cover the countryside as a resource hinterland; agriculture; recreational, education and scientific concerns in the countryside; and policy, planning and administration.

University of Guelph, Centre for Resources Development. *Project Mississauga: An Evaluation of Agriculture in an Area Undergoing Urbanization*. The Centre (Guelph, Ont. N1G 2W1), publication 81. June 1977.

A study, prepared by graduate students, that examines means of encouraging interim agricultural production on lands designated for urban development.

Williams, G.D.V., "Urban Expansion and the Canadian Climate Resource Problem", *Greenhouse-Garden-Grass*, Spring 1973, Vol. 12 (1), pp. 15-26.

Yeates, Maurice. *Mainstreet: London to Quebec*. Toronto: Macmillan, 1975. Paperback, 431 pp. $5.95.

More than half of Canada's population lives along the lower Great Lakes and the St. Lawrence River, between Windsor and Quebec City. This study, commissioned by the Ministry of State for Urban Affairs, analyzes the form of this axis, its growth, the use of land, housing, its economic structure, interactions within it, structure and finance, and an outlook for the year 2001. See also Lewis.

Chapter 4

4. Selected Activities



Central to the environmental movement of the 1960s was a deep concern over the impact of human activities on natural environments. Controversy and conflict during that period brought into sharp focus the need for changes in the way certain activities, with potential for serious adverse environmental effects, are committed, planned and carried out.

As more is learned about the way environments function and the nature of environmental problems, the kinds of changes needed in planning and managing human activities similarily become more apparent. For example, if environmental impacts are to be effectively minimized, the full range and sequence of interrelated actions involved in energy development, water resources development or any other planned *set* of activities (not just individual projects) must be examined in order to determine when, where and how to intervene for environmental purposes.

This chapter addresses seven sets of activities prominent among those generating adverse environmental effects: agriculture, urbanization, disposal of solid and hazardous wastes, resource development, transportation, recreation and energy projects.

4.1 Agriculture

With a total area of nearly a million hectares (over 2.3 million acres) Canada is land-rich. But only 13% of its territory is suited for agricultural production and less than half of this is Class 1, 2 and 3 land capable of sustained production of common field crops. Furthermore, only 7% of the total land area is actually farmed. Not all of the land suitable for agriculture is used for that purpose and some of it, now under forest or in climatically marginal areas, is likely to remain unimproved farmland.

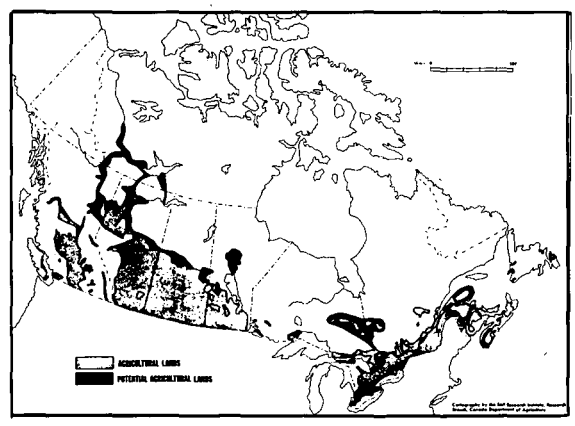


Figure 4.1 Agricultural Lands in Canada.

Source: Soil Research Institute, Agriculture Canada, 1973.

Since World War II, advancements in agricultural technology have greatly increased Canada's food-growing capability. More of the land on farms is improved farmland – an average of 63% today compared with 50% in 1956 and only 30% in 1930. Due largely to mechanization and chemicals, land is now used more intensively and yields are higher. From 1958 to 1969 physical production rose at a rate of 2.3% per year (Mitchell, 1975). Pound per pound we now export more food than we import, making Canada one of the world's few remaining net exporters of food and Canadian agricultural land a vital resource, not only provincially and nationally but world-wide.

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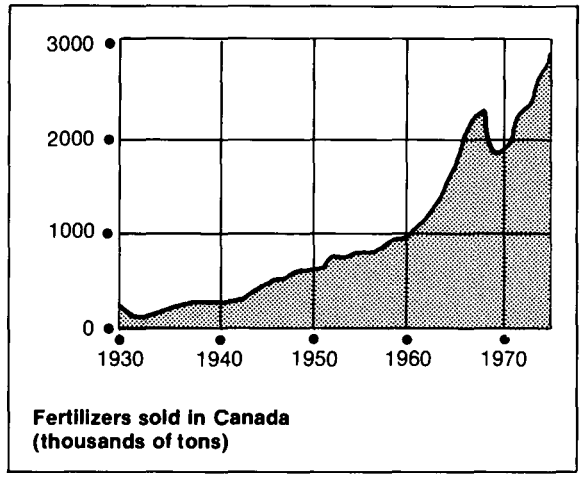


Figure 4.2 Fertilizers Sold in Canada, 1930-1974

Source: Statistics Canada, *Human Activity and the Environment* (Ottawa: Statistics Canada, 1978).

Several recent studies question the price of success, however, and raise doubts about the advisability of continuing present agricultural practices. Large-scale specialized operations characteristic of modern agriculture were made possible by five factors, each discussed below: synthetic fertilizers, pesticides, animal feedlot production, cheap fossil-fuel power, and genetic selection and hybridization. Productivity increased but with it came more environmental pollution, displaced human labour and massive energy use.

Synthetic fertilizers. The Science Council of Canada reported in December 1976 that the use of inorganic fertilizers by Canadian farmers increased at an average annual rate of 7% from the early 1960s to 1970, and increased sharply after that. Nitrogen is the most widely used fertilizer, followed closely by phosphorous and potassium. Synthethic fertilizers are necessary to ensure high yield and replace plant nutrients lost from the soil as a result of natural or man-made processes. But they are also a major source of water pollution. Runoff from fertilized fields can overload lakes and streams with excess nitrates and phosphates that stimulate growth of green and blue-green algae. The main potential ecological effects are: a decrease in the diversity of aquatic species as algae crowd out other plant life and interrupt complex food chains; a release of malodorous compounds and possibly toxic chemicals by algae blooms, which can limit the recreational use of the water and kill fish; and depletion of oxygen as dead plants

Table 4.1 Impact of Fertilizers: Environmentalists vs Agriculturalists

Environmentalist Position	Agriculturalist Position
Fertilizer runoff contributes 30 to 50% of the nitrates in ground and surface waters.	Nitrogen fertilizers undoubtedly contribute nitrates to ground water systems in some localities but the data are too scanty and conflicting to make generalizations. Amounts vary considerably with conditions and locations and are usually less than 30 to 50%. Excess nitrates more often come from treated sewage, soil erosion, food processing and feedlot wastes.
Widespread fertilizer use causes deterioration of the soil's ability to hold nitrogen.	Nitrogen is naturally lost by erosion, leaching, volatilization, denitrification and harvesting crops. The purpose of its widespread use our soils would now be depleted to a much greater extent.
Fertilizer runoff is a major cause of eutrophication.	Although some nitrates in fertilizers can run off, phosphorous (the main cause of eutrophication) is held strongly by soil particles so that relatively little is lost.
	Municipal and industrial wastes and detergents are the main cause of eutrophication. Fertilizers could contribute in estruarine areas where nitrogen is the limiting agent and where agricultural use of land is high.
We are in increasing danger of being poisoned by excessive nitrate concentrations in public water supplies and wells and from excessive concentrations in baby food. If children under 4 months of age are exposed to nitrate levels exceeding the public health limit (10 milligrams of nitrate per liter) they can get sick and even die of methemoglobinemia.	In several surveys less than 1 percent of public water supplies exceeded the safe limit, but a number of rural wells exceeded the limits especially in California, Missouri, Illinois, Minnesota, and Wisconsin. Since 1944, 41 infants have died from methemoglobinemia in the U.S. and 80 in Europe. All cases but one involved poisoning from rural wells, usually from septic tank or feedlot runoff, and most cases occurred between 1945 and 1950. Commercially prepared baby foods with high nitrate concentrations have caused only one reported illness and no deaths in the U.S.

Nitrates and nitrites used as food additives for colouring, flavouring, and anti-bacterial agents can react to form nitrosamines which are known to cause cancer, birth defects, and genetic mutations in test animals.	Little is known about the levels of nitrosamines in foods because there is no sensitive method for detection. The potential effects of nitrosamines on humans are being studied extensively at present, and it could be a serious problem.
The fertilizer runoff problem is so serious that we should ban or sharply reduce the use of fertilizers in the U.S.	With increasing use and no program for control, fertilizer runoff could become a serious problem in some areas. Control should be based on reducing excess application by farmers, application at the right time, and reduction of use in highly critical watershed or groundwater basin areas. If fertilizer use were banned, food prices could rise considerably, soil fertility would decline sharply, and a large amount of additional land would have to be cultivated to feed our population. Much of this would be marginal land with potential for increased erosion, which could add more nitrates than fertilizer on existing cropland. This could use up land we should reserve for recreational and wildlife habitats.

Source: G. Tyler Miller, Jr., *Living in the Environment: Concepts Problems and Alternatives* (Belmont, CA: Wadsworth Publishing Co., 1975).

decompose, which can lead to a shift to less desirable fish species such as carp. The significance of the impact of fertilizers on water quality and the eutrophication process is a debatable issue (Table 4.1); for example, the movement and chemistry of nitrogen and phosphorous in soil are not well understood. Variables that determine the potential for surface or ground water contamination include soil type, topographic features, timing and amount of fertilizer application, and weather.

Pesticides. Farmers have come to rely on chemicals to kill insects, undesirable plants, weeds, fungi, rodents and other pests. Sales of pest control products in Canada rose sharply over the past 30 years. The greatest demand is for herbicides. Among the many kinds of herbicides, the

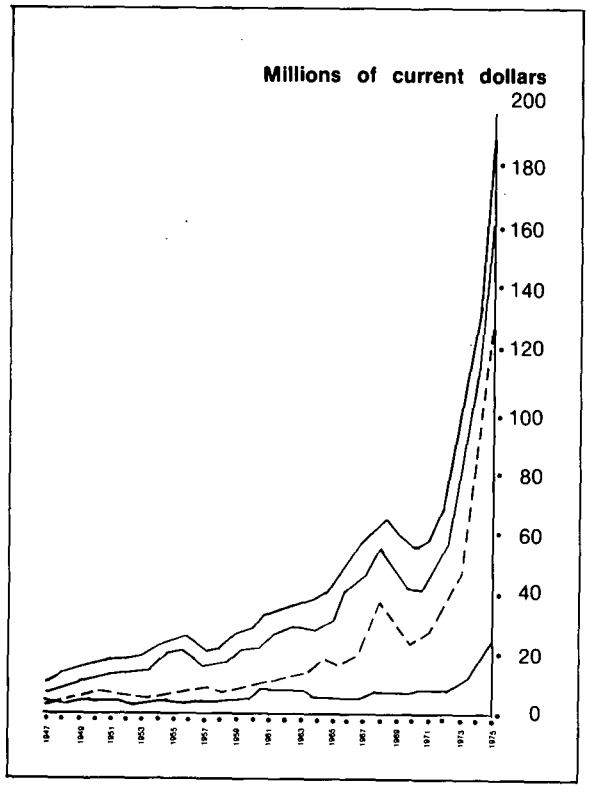


Figure 4.3 Growth in the Sale of Pest Control Products in Canada, 1947-1975

Source: Statistics Canada. *Human Activity and the Environment* (Ottawa: Statistics Canada, 1978).

three groups most extensively used are chlorinated hydrocarbons (DDT, aldrin, dieldrin, lindrane), organic phosporous (diazinon, malathion, parathion) and carbonates (carbyl, zireb, maneb). The fundamental threat posed by pesticides results less from the total amount used than from their persistence and accumulation or magnification through food chains. Potential adverse effects of pesticides include: immediate toxic threats to man; possible long-term genetic and health effects; inadvertent reduction in the variety of soil micro-organisms with consequent reduction in the ability of soil organisms to decompose nutrient sources; ecosystem instability through simplification of ecosystem structure and disruption of food chains and predator-prey relationships; and lower reproduction potential in some species. It is important to note that use of chemicals in agriculture has not had serious environmental effects everywhere in Canada; it is mainly in those areas practicing agriculture intensively and susceptible to environmental degradation.

Table 4.2 Persistence of Common Pesticides

Type	Persistence
Chlorinated hydrocarbons (DDT, DDE, DDD, aldrin, dieldrin, endrin, heptachlor, toxaphene, lindane, chlordane)	high (2 to 15 years)
Organic phosphates (malathion, parathion, azodrin, phosdrin, diazinon, TEEP)	low to moderate (normally 1 to 12 weeks but can be up to several years)
Carbamates (carbyl, zireb, maneb)	Usually low (a few days to 2 weeks)

Source: G. Tyler Miller, Jr., *Living in The Environment: Concepts Problems and Alternatives* (Belmont, CA: Wadsworth Publishing Co., 1975).

Feedlot production. Although feedlot production was rare a couple of decades ago, the Food Prices Review Board reported that 70% of all beef cattle passed through a feedlot system in 1972. The shift from pastures and open ranges to feedlots, where animals (cattle, hogs, poultry) are concentrated in relatively small quarters and given quality feed to prepare them for market, was motivated by the search for higher output and more efficient production. One adverse consequence has been the concentration and accumulation of wastes. Tons of waste in feedlots present a hazard to air quality (dust, ammonia gas, odour). Water quality suffers when runoff and inadequate disposal contaminate lakes, streams, groundwater and municipal supplies. Getting rid of the waste is not as easy as it once was; synthetic fertilizer has largely displaced manure in the marketplace. Waste management is the main problem associated with feedlot products but food quality is also a major concern (treating animals this way presents a moral issue still latent). Animals are given large doses of antibiotics, to prevent any disease problems that may result from confining them in small areas, and growth stimulants to increase the rate of gain (Geno and Geno). It is suspected that these additives adversely affect the nutritional quality of the processed meats. They may also have potential to create human health problems.

Fossil-fuel power. Moving from traditional to modern agriculture – from labour to machines, from solar energy to chemical energy – involved a signficant switch in the kind and amount of energy inputs. Today's farm operation requires many diverse forms of energy: gasoline and diesel fuel to run tractors and other machinery, propane to operate grain driers, electricity to

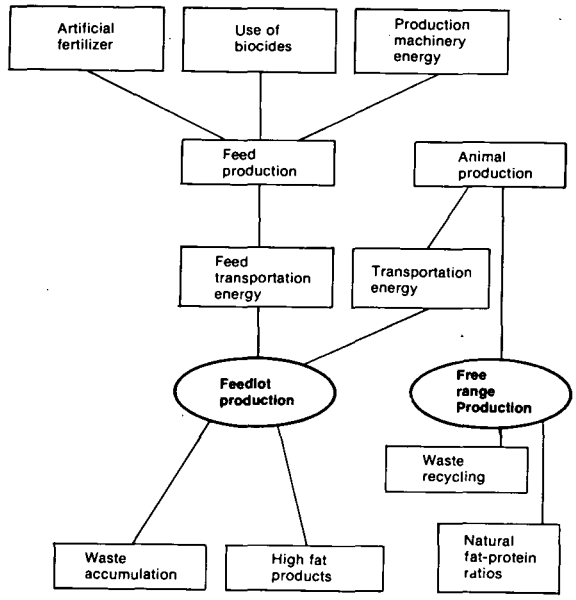


Figure 4.4 Feedlot vs. Free Range Production

Source: Barbara J. Geno and Larry M. Geno, *Food Production in the Canadian Environment* (Ottawa: Science Council of Canada, Dec. 1976).

power milking equipment, and fertilizers and pesticides to protect crops. The largest energy inputs, fertilizers and fuels, comprise a significant proportion of all petroleum products marketed in Canada. Commoner argues further that the move away from solar-efficient agriculture has been a move away from self-reliance to dependency on the outside economy. Unstable energy supplies and rising prices may soon pose a serious threat to the security of Canada's agricultural economy.

Genetic selection and hybridization. In natural systems, species diversity is related to ecosystem stability. With some exceptions, greater variety tends to increase the potential to adapt to the hazards of weather, disease and pests. Farming, once diversified, now consists primarily of monoculture – single large fields of wheat, corn, oats and other crops. Mechanized harvesting efficiency relies on crop simplicity which in turn depends on ever-increasing quantities of synthetic fertilizers and pesticides for support and protection. Diversity is reduced in another way by modern agriculture: genetic simplicity. A key factor in modern agriculture's success has been the development of selected strains of high-yield, more efficent crops, livestock and poultry. Narrowing the genetic base of crops increases their vulnerability to new pathogens.

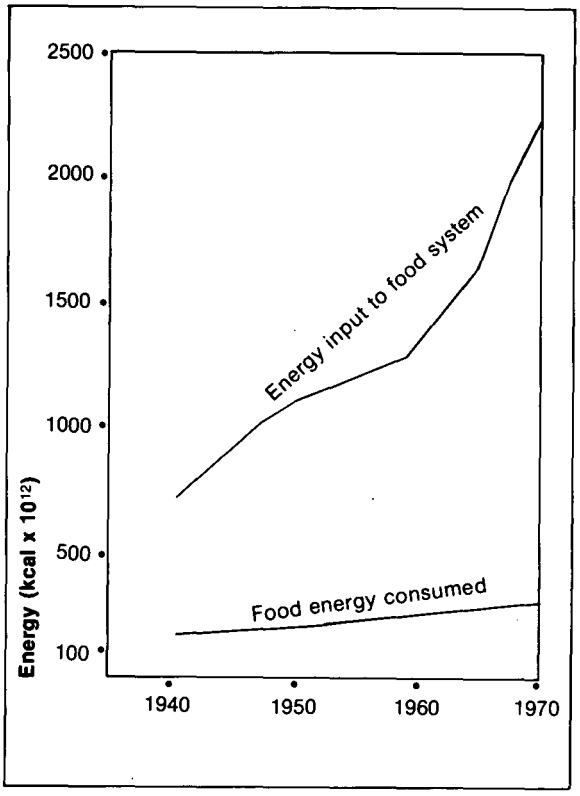
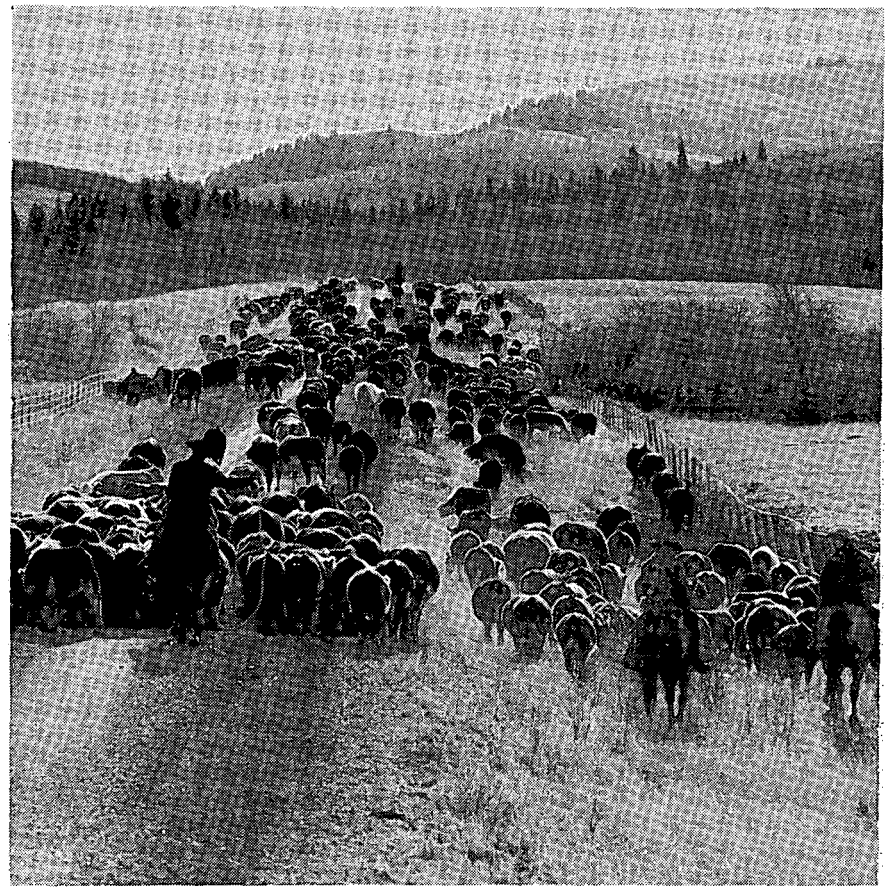


Figure 4.5 Energy Use in the Food System

Source: Barbaro J. Geno and Larry M. Geno, *Food Production in the Canadian Environment* (Ottawa: Science Council of Canada, Dec. 1976).



Agriculture can have additional adverse effects. Clearing woodlots or stream banks for agricultural purposes renders the land more susceptible to erosion; people have forgotten the Thirties. Draining land for agricultural use (in the Maritimes, Ontario, etc.) often involves extensive reclaiming of wetlands, especially marshes, eliminating these areas and the values they represent. Such drainage can also result in lowered water quality in streams (silt loads, nutrients, increased temperature) and flooding problems downstream. Careless cultivation can produce water and wind erosion with loss of valuable topsoil and subsequent detrimental consequences for receiving streams and lakes, as the recent report on pollution of the Great Lakes from land use activities dramatically reveals. The current shift to cash crops, where fences are removed and as much land as possible is farmed for maximum quick return, can exacerbate the foregoing effects as farmers pay less attention to crop rotation, topsoil management and conservation practices generally.

The adverse environmental effects of agriculture are becoming increasingly apparent, as are the adverse environmental effects of pollutants and urbanization *on* agriculture. Governments and others are reacting – Ontario's new Drainage Act requires environmental assessment of drainage projects, for example – and these concerns are being reflected in other decision processes. One instance is the EARP report on a proposed uranium refinery at Port Granby, Ontario (referenced in 2.2 Radiation) which recommended against the project largely on the basis of its intrusion into a Class 1 Agricultural area. On the other hand, agriculture's adverse environmental effects are well embedded in Canada's cultural and economic system. Change will not be easy. Rapidly escalating energy costs

plus limits in productivity increase may force the move to agricultural practices that are environmentally benign, but a barrier to this trend is reflected by the contradiction between the widespread concern for preserving agricultural land and the unwillingness of consumers to pay prices for agricultural products sufficient to sustain economic farm operations. As Stokes points out, while society may worry about maximizing production and minimizing expensive energy use, the individual farmer is most worried about increasing personal income and improving the rural standard of living. There is an obvious need to consider agriculture's economic-equity and environmental problems simultaneously.

Case Study 54
Farm and Stream Guidelines in B.C.
Submitted by George Atamanenko, B.C. Agricultural Land Commission

In 1977 the B.C. Federation of Agriculture initiated an inquiry into government constraints on farmers attempting to manage water in their farm operations. The Federation believes that the management of farmland near fish-supporting streams and the use of water for agriculture can co-exist without undue harm or restriction to fish or wildlife. Farmers feel limited by administration of federal and provincial legislation governing water use and control; they see a need to develop common-sense guidelines for that resource.

A draft discussion paper, issued in May 1978, deals with the farm and stream issues. Detailed examples of practical water management problems and water license permit requirements are now being worked out. Under consideration is the publication of a brochure outlining drainage and watercourse management for the farmer, establishment of a review panel to deal with delays in govenment approvals and a streamlined procedure for obtaining water license permits.

The study is continuing. Final guidelines are expected later in 1978.

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Case Study 55
Subsidence in the Holland Marsh, Ontario
Submitted by D.W. Hoffman, University of Guelph

The Holland Marsh, located north of Toronto, is a high-productivity market gardening area. Success in vegetable production on organic deposits such as those found in the Marsh depends on the durability of the deposit and its depth. Continued cultivation, drainage and wind erosion result in soil losses by oxidation and physical removal. Research has been undertaken to determine the rate of loss.

Subsidence rates can be reduced by proper water control. Depending on the crop to be grown, water levels must be maintained in order to keep the soil column moist but not saturated, to depths of 45-75 cm. Windbreaks should also be established to reduce wind erosion.

Apparent lack of concern by owners and managers in the Marsh has resulted in an annual subsidence of approximately 2.5 cm. Shelterbelts have not been established, and, although standards have been set, no means of enforcement exists.

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Information Resources

See also:
2.1 Land Use and Misuse
2.4 Soil/Soil Capability
3.7 The Rural-Urban Fringe

Beaubien, Charles and Tabacnik, Ruth. *People and Agricultural Land.* Ottawa: Science Council of Canada, June 1977. Paperback, 137 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $4.00.

Foodland preservation in the face of increasingly intense and multi-faceted competition for Canada's best agricultural land is the focus of this report. The main issues it raises are the need for greater emphasis on rural planning and development based on a perception of rural life and resources (rather than as a residual of urban planning and development), the need to give precedence to preservation of prime agricultural land and the activities on it, and the need for political will to supplant pious intention and superficial debate. Factual, persuasive and well-equipped with practical examples.

B.C. Land Commission. *The B.C. Land Commission: Keeping the Options Open.* British Columbia Agricultural Land Commission (4333 Ledger Ave., Burnaby, B.C. V56 3T3), 1975. 12 pp. Free.

A popular-level brochure that describes the rationale for and operations of the Commission, established in 1973 to preserve agricultural land for farm use. Protective zones are created and shown on Agricultural Land Reserve Plans which contain regulations defining permitted land-use types; the Commission can also purchase, hold, sell or lease agricultural land. Initially, the Commission (then called the B.C. Land Commission) was also concerned with greenbelts in and around urban areas, parkland and urban land banks. In 1977, however, its functions were limited to the long-term encouragement of agricultural land use and the establishment, maintenance and preservation of farms, and its name was changed accordingly. Related references include: *Let's be Good Neighbours*, 1977, a foldout describing the minimum distance program to keep urban and agricultural uses suitably separated; *The Land Commission Act*, 1973 and subsequent amendments (especially 1977) and regulations (1974, 1975); and *Provincial Land Commission, Province of British Columbia, Annual Report Year Ended March 31, 1977.*

Commoner, Barry. *The Poverty of Power.* New York: Bantam Books, 1977. Paperback, 297 pp. $2.75.

Commoner argues that the farm has become less self-reliant and more dependent on the outside economy. Traditional agriculture used solar energy efficiently because it was based on a sequence of crops that were green for the longest possible yearly period, that were in a rotation, and that were mixed with animal production. The move away from solar energy to industrial-based energy (machinery, fertilizers, pesticides) brought with it, Commoner contends, two interrelated problems: environmental pollution and economic (decreased net income and displaced farm labour).

Crosson, Pierre R. *Environmental Considerations in Expanding Agricultural Production.* Resources for the Future Inc. (1775 Massachusetts Ave. NW, Washington, DC 20030), 1975.

Eckholm, Erik P. *Losing Ground: Environmental Stress and World Food Prospects.* New York: W.W. Norton, 1976. Paperback, 223 pp. $4.35.

Ecoplans Ltd. *Some Ecological Aspects of Canadian Agriculture.* Science Council of Canada, Committee on Population and Technology (150 Kent Street, Ottawa K1P 5P4), 1975.

This report comments on three questions: how will Canada's "carrying capacity" be affected through substitution of more energy-saving consumption patterns? What are the most promising alternatives and ecologically preferable technologies now available to Canadian farmers? And which agricultural land uses are now ecologically inappropriate, how intensive are they, what yield differences would result from rectifying the situation, and what ecological guidelines should be followed in selecting potential land for production?

Environment and Land Use Committee. *Policy Guidelines for the Allocation and Disposition for Crown Arable Lands Suitable for Agricultural Development.* B.C. Ministry of the Environment, Land Management Branch (Parliament Buildings, Victoria V8V 1X5), Nov. 1977. 38 pp.

Problems of agricultural leasing focused on determination of arable lands using biophysical and economic criteria, resolution of resource conflicts, consideration of regional sensitivity in climate and soil conditions when evaluating lessee performance, and rental rates. This report sets out the major objectives for developing arable Crown land, examines the supply question and the value of these lands, outlines a planning procedure for determining which potentially arable lands should be allocated to agricultural use, describes more specific policies for developing these lands, and discusses leasing regulations and other specific policy issues. See also: *Policy Memorandum – Division 3: Agricultural Lease*, Dec. 1977, 10 pp.

Food Prices Review Board. *Feed Grains, Forage and Food Supplies.* Ottawa: Food Prices Review Board, June 1975.

Geno, L.N. *Energy, Agriculture and the Environment.* Environment Canada (Ottawa K1A 0H3), 1975.

Geno, Barbara J. and Larry M. *Food Production In The Canadian Environment.* Ottawa: Science Council of Canada, December 1976. 28 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $2.25.

The authors examine current agricultural operations from a number of perspectives: how to get the most out of the present system by increasing the amount of land farmed; preserving current farmland; improving management practices and marketing systems; constraints to increasing production such as energy supply, biological limits and environmental impacts; and directions towards environmentally appropriate agriculture including energy conserving options and ecological alternatives.

Goldsmith, Edward, "The Future of an Affluent Society: The Case of Canada", *The Ecologist*, Vol. 7, No. 5, June 1977.

This controversial report, originally commissioned by Environment Canada, argues that Canadian agriculture is highly vulnerable to climatic changes and energy costs which affect the price of inputs (fuel, fertilizer, pesticides and machinery), that prospects are poor for increasing productivity by expanding the land base (in fact, farmland is being lost to urbanization and non-agricultural uses), and as a result, that Canada's ability to meet its own food needs, let alone the world's, is considerably lower than is generally thought. Further annotated in 1.2 Characteristics of Environmental Problems.

Green Zone Committee, Ministry of Agriculture and B.C. Land Commission. *Agricultural Zoning and Waste Management.* B.C. Agricultural Land Commission (4333 Ledger Ave., Burnaby, B.C. V5G 3T3), 1977. 57 pp.

As urban populations increase, more restrictive land use and building site regulations are introduced that limit the viability of certain types of agriculture. This report documents the work of a committee that investigated this problem in several municipalities in the Lower Mainland of British Columbia, reviewed methods used by other jurisdictions in Canada to handle similar problems, and analyzed five alternative approaches to resolving agricultural-urban conflicts (refining existing programs, municipal regulation by permit, provincial regulation by permit, building regulation by standardized formula, and green zone concept) concerning building site and waste management.

International Reference Group on Great Lakes Pollution from Land Use Activity (PLUARG). *Environmental Management Strategy for the Great Lakes System.* International Joint Commission (100 Ouellette Ave., Windsor, Ont. N9A 6T3), July 1978. 173 pp. Free. Castrilli, J.F. and Dines, A.J. *Control of Water Pollution From Land Use Activities in the Great Lakes Basin: An Evaluation of Legislative and Administrative Programs in Canada and the United States.* IJC, March 1978. 109 pp. Free.

Annotated in 2.3 Water Quality. Includes references to lake pollution from agricultural activity in the Basin.

Kennedy, K. et al., "Agriculture and the Environment", *Environment News*, Vol. 1, No. 4, Oct.-Nov. 1978. Available from Alberta Environment, (9820 – 106 St., Edmonton T5K 2J6). Free.

Entire issue devoted to agricultural/environmental conflicts. Articles include "Problem Wildlife and the Farmer", "Agriculture and Pollution", "The Top-soil Tug of War", and "Agricultural Trends and Environmental Quality".

Lassey, William R. *Planning in Rural Environments.* New York: McGraw-Hill, 1977. Hardcover, 257 pp. $17.95.

Annotated in 1.3 Characteristics of Environmental Planning.

McCallum, Bruce. *Environmentally Appropriate Technology: Renewable Energy and Other Developing Technologies for a Conserving Society in Canada.* Edition IV. Ottawa: Environment Canada, 1977. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $3.75 ($4.50 outside Canada).

Agriculture is covered in the section on pages 128-140.

Merrill, Richard (ed.). *Radical Agriculture.* New York: Harper and Row, 1976. Paperback, $6.95.

Miller, G. Tyler, Jr. *Living in the Environment: Concepts, Problems and Alternatives.* Belmont, CA: Wadsworth Publishing Co., 1975. Hardcover, 503 pp. $14.95.

See "Eutrophication and Agricultural Water Pollution", pp. E109-119. Eutrophication is discussed in Case Study 39, under 3.3 Lakes.

Nowland, J.L. and McKeaugue J.A., "Canada's Limited Agricultural Land Resource," in Krueger, Ralph, R., and Mitchell, Bruce (eds.). *Managing Canada's Renewable Resources.* Toronto: Methuen, 1977. Paperback, 333 pp. $9.95.

Ontario Institute of Agrologists. *Foodland: Preservation or Starvation.* Ontario Institute of Agrologists (c/o W.J. McPherson, P.Ag., Secretary-Manager, R.R. 1, Hillsburgh, Ont.), June 1975.

Ontario Ministry of Agriculture and Food. *Green Paper on Planning for Agriculture: Foodland Guidelines.* OMAF (Queen's Park, 1200 Bay St., Toronto, Ont.), Feb. 1977. Free.

Ontario Ministry of Agriculture and Food et al. *Agricultural Code of Practice.* OMAF (Queen's Park, 1200 Bay St., Toronto, Ont.), 1976. Free.

Provides standards for agricultural operations to minimize their adverse impacts.

Pearson, Norman. *Food Land and Energy Planning.* Food Land Steering Committee (c/o Lloyd Moore, Chairman, P.O. Box 6, Listowell, Ont.), 1976. 2 volumes.

A submission to the Royal Commission on Electrical Power Planning. Volume I discusses the food lands of Ontario (which has half of Canada's Class 1 agricultural land), production trends on these lands, the physical base for agriculture (soil, climate, physiography, etc.) and the significant farming areas. It then compares the effects of electric power generation and transmission on foodlands in Southwestern Ontario and the Canadian Shield. Volume II looks at the future needs for Ontario foodlands, considers provincial/regional/ local planning in relation to energy, and delves further into socio-economic impacts and other effects of energy facilities. Pollution of agricultural crops, especially by ozone, is covered in the last section.

Sargent, Frederic O. *Rural Environmental Planning.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), 1976. Paperback, 199 pp. $7.00.

Annotated in 1.3 Characteristics of Environmental Planning, and in 5.8 Public Participation.

Select Committee on Land Drainage. *Agricultural Land Drainage in Ontario.* June 1974. 104 pp. Available from Government of Ontario Bookstore (880 Bay Street, Toronto M7A 1N8), $0.50.

Science Council of Canada. *Population, Technology and Resources.* Ottawa: The Council, Report No. 25, July 1976. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $2.50.

This report succintly analyses three agricultural issues: loss of agricultural land to urbanization; the constraints to increasing agricultural productivity, especially for bringing marginal land into use; and the need for waste reduction. Agricultural operations are wasteful of grain and energy. Animals in feedlots are fed high quality grains to induce rapid weight gains. Feeding cattle grain, the Council argues, not only shrinks the available food supply but is also inefficient because it takes 10 to 16 pounds of grain to produce one pound of beef. The Council notes that feedlot manure could be used as fertilizer fuel (methane), and to some extent, animal feed, rather than being regarded as "waste".

Steinbart, I.S. and C.E., "Energy Use in the U.S. Food System", *Science* 184, No. 4134, 19 April 1974, pp. 301-316.

Stokes, Bruce. *Local Responses to Global Problems: A Key to Meeting Human Needs.* Worldwatch Institute (1776 Massachusetts Ave. NW, Washington, DC 20036), Feb. 1978. Paperback, 64 pp. $2.00.

The section entitled "Small is Beautiful", pp. 18-28, discusses food self-reliance: for example, home gardening in the United States, where an estimated 32 million households approximately 43% of all families, raised fruits and vegetables in 1977 in backyards, on balconies and in city lots for a total of seven million acres of production, compared with practically zero acreage in 1971. Recent data in the U.S. suggest that the long-standing trend toward farm consolidation is perhaps beginning to be offset by a resurgence of back-to-the-land interest in small farms; Canadian experience in the Maritimes is similar. Changing conditions may be giving new environmental, economic and social advantages to small-scale farming. Purchasing the land is a stumbling block, though, and studies show that lack of security of tenure is in turn a major barrier to adoption of soil conservation practices.

Toner, William. *Saving Farms and Farmlands.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), 1978. 46 pp. $6.00.

Addresses the need for preservation of prime agricultural land: the reasons for preserving farmlands, planning approaches to preservation, and major zoning schemes.

University of Guelph, Centre for Resources Development. *Planning for Agriculture in Southern Ontario.* Ontario Ministry of Agriculture and Food (1200 Bay St., Toronto, Ont.), 1972. 331 pp. $3.00.

The study's objectives were: to provide input necessary to decide which areas should be used for agriculture; to identify key factors affecting agricultural land use and change over the next 20 years; to determine interactions between agriculture and the environment; and to suggest priorities, identify policy issues and means of implementation. The report presents characteristics of farms and their resources, the diminishing land base for agriculture, agricultural responses to change, agricultural land values, regions and planning for agriculture, future food demand and production, policy guidelines and conclusions.

University of Guelph. *Future Agriculture in Ontario.* University of Guelph (Guelph, Ont. N1G 2W1), Notes on Agriculture, Vol. 12, No. 3, July 1976. Free

A series of papers by various authors providing the reasons for more technology to increase production. *Notes on Agriculture* is published at irregular intervals by the Ontario Agricultural College as a public information service.

Wade, Nicolas, "A Message from the Corn Blight: The Dangers of Uniformity", *Science* 177, No. 4050, 25 August 1972, pp. 678-679.

Warkentin, B.P. *Agriculture, Food and Renewable Resources in a Conserver Society.* GAMMA (Suite 210, 3535 Queen Mary Ave., Montreal), 1975.

4.2 Urbanization

Urban land accounts for only 1% of Canada's total land area. But area alone is a misleading indicator of the significance of urbanization for environmental quality. Population size, density, location, pattern of development, urban form and urban lifestyle all have environmental implications. Concentrating population and economic activity in relatively small areas also concentrates environmental stress that may exceed the assimilative and regenerative capacities of environmental systems. These impacts in turn may reach far beyond the local environment. For the environmental planner this creates two problems: the need to prevent or reduce to an acceptable level the impact of urban development on the environment's capacity to provide materials and resources and accommodate wastes; and the need to maintain or enhance the quality of the urban environment itself. These concerns may produce a dilemma: that greater human needs and wants create increasing environmental stress while demanding increased environmental quality.

Acknowledgements 4.2

This section includes contributions from:

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From 1941 to 1975 Canada'a population doubled from 11.5 to 23 million, and population shifted from 56% to 75% urban. Projections of the population of Canada's 22 census metropolitan areas by 2001, anticipate minimum growth of 50%. Six of these areas are expected to double their population in the period 1971 to 2001, according to the Science Council of Canada. The massive population increase experienced in the 50s and 60s may have come to an end but, as Wiesman points out, Canadian society has considerable momentum for growth. Even with zero net population growth and a birth rate at replacement level, the country's total population will increase by about 25% to 28 million within the next 25 years. The problem, however, is not so much total urban growth, as where and how it will occur, what resources (including energy) it will consume, the industrial and technological support it will require, the amount and kinds of wastes it will create, and ultimately the quality of life it will permit.

As a city spreads rapidly over the landscape, vegetation is cut back, marshes are filled, wetlands are drained, topsoil is removed and land is paved over. Ecological systems may be degraded or destroyed and vital environmental processes such as the natural water cycle irreversibly altered. Unfortunately, the overall ecosystem impact of urbanization defies prediction, given the present state of knowledge (Jameson). Adding to the planner's problem is the *pervasive* influence the continual process of urban development and expansion has on environmental quality. This is emphasized by Coughlin in a study of the effect of urbanization on water quality where he states that no matter what is done with sewage, urbanization will inevitably lower water quality. Approaches have been devised, however, for determining the impact of development on specific ecosystem properties such as terrestrial or aquatic productivity. Thus, while the overall impact of urbanization cannot be avoided, some specific impacts can be prevented and overall impact minimized through careful site selection and design, timing of development, and construction practice. For example, accompanying the design and building of new urban areas with innovative stormwater systems can substantially reduce the adverse water quantity and quality effects of urbanization and reduce sewerage costs (see 2.3 Urban Runoff).

The urbanization commitment, often made in the earliest stages of planning, needs to be given close scrutiny. In areas where growth is inevitable and it is merely a matter of location, the capacity and timing of major infrastructure facilities (in particular, expressways, trunk sewer and water lines, and treatment facilities) have a major impact on where, how much and how fast new development proceeds. These services are often planned without recognition of their land use and environmental impacts (see Urban Systems Research Engineering). They may be overdesigned as the engineers attempt to build in a safety factor as a hedge against future uncertainty. The excess capacity subsequently raises land values and either attracts urban expansion or creates the expectation of it. Agriculture may then become non-viable and environmental resources gradually eroded.

Urbanization also has a direct link to energy use, although their interdependency is only beginning to be understood. Energy is consumed in creating land uses and in subsequent activities. Enormous amounts of energy are now wasted in urban areas, which is both a problem and an opportunity. Improving the geometry of streets to take advantage of the sun and climate, undertaking district heating schemes, recycling waste heat, planning energy-efficient land use, promoting higher-density and cluster development, improving building design, reducing use of the automobile and encouraging more use of transit, and zoning for mixed use are examples of measures that could be used to capitalize on the opportunity to "save" wasted energy. Substantial barriers exist to their implementation, however.

Urbanization can also create environmental stress indirectly, as well as directly. Jaakson identifies three further kinds of adverse effects: 1. those which result from depopulation of rural areas, urbanization essentially being the process of change from rural to urban in favour of the latter; 2. those created indirectly by the massive demands of the urban system for energy, food and other resources, goods and services, and waste disposal; and 3. the subtle and often catalytic effects urbanization has on values, attitudes and behaviours which pervade the man-environment relationship.

Regarding urbanization as a process underscores the interdepency of urban and rural areas, and differs from the view behind economic systems that treat rural areas as hinterlands of the metropolis. Many urban Canadians

are ambivalent about rural areas, seeing them as "natural environment", yearning for a (romanticized) rural life-style, while regarding them as exploitable and vaguely inferior. The average urban individual, government agency and private firm adopts an approach of "rational self-interest": exploiting one rural area (e.g. by dumping waste in it) and deriving benefit from the environmental quality of another (such as the cottage).

Large-scale natural resource development, transportation and energy projects dramatically affect the natural environment. By comparison, a service line here or a park there, in an urban area, hardly seems environmentally significant, especially if well designed. But the entire *process* of urbanization, over time and especially in large concentrations on sensitive sites, has a massive environmental effect. Urbanization, or even the possibility of it, fundamentally transforms the environmental system. When an area on the urban fringe is committed to "development", one set of expectations (about the countryside) is replaced by another (about the city). In the face of awesome man-made structures, environmental resources decline in importance. In the early critical stages of an areas's urbanization when these resources still exist, their loss may be downplayed by promises of sound design and careful landscape treatment later on. Gradually, because they lack sufficient value to compete or because the natural system (e.g. wildlife) cannot tolerate the stress created by concentrated human activity, natural resources dwindle until a new environment results. It is a slow, bit-by-bit process of attrition, hardly noticed and seldom monitored.

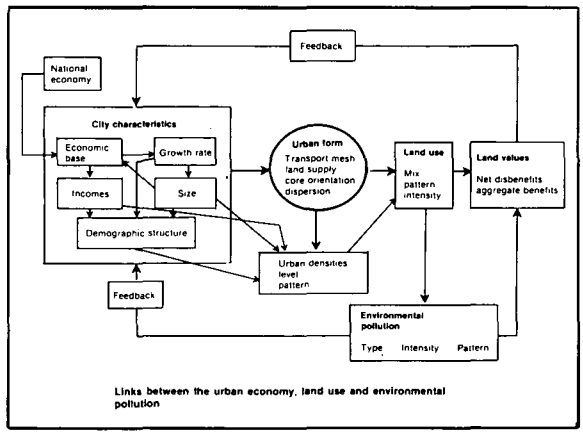
Urbanization need not necessarily and does not always result in a seriously degraded natural environment. Examples are beginning to emerge (see 5.4 Plans) where urban development is planned and allocated according to the capacity of natural systems to sustain it. So far, however, these are rare exceptions. Where the urban result has been environmentally favourable, often in small towns, good fortune seems the best explanation: a slow growth rate and the right kind of urban development, a particularly resilient natural setting (or little amenable environment to be lost), and special care in the process of urban growth may have made the difference. On the other hand, large rapidly growing areas, located on the most biologically productive lands, creating much higher levels or environmental stress than ever before and suffering from an accumulation of past mistakes, live dangerously if they leave their environmental quality to chance. Deliberate environmental management is needed to identify the limits on urbanization for given locations, to engender new levels of popular environmental concern, to reveal environmental consequences of alternate causes of action, to demonstrate environmentally sound ways to achieve urban settlement, and to monitor environmental change.

> *Urbanization, with its comcomitant maze of decisions affecting the use, development, maintenance and redevelopment of land, is perhaps the most important determinant of environmental quality, particularily the quality of the urban environment where the vast majority of our citizens live.* Kaiser.

Case Study 56
Land Use, Urban Form and Environmental Quality

One of the few attempts to determine how environmental quality is related to the form and pattern of urban development is an intensive 15-month study, conducted in 1972-3 by a research team at the University of Chicago for the U.S. Environmental Protection Agency, under the direction of Dr. Brian Berry. This study examined the relationship between environmental pollution and the type and intensity of urbanization in 76 centres in the United States. Its report was intended to provide an understanding of those urban forms that naturally generate the lowest pollution levels, the environmental consequences of contemporary urban dynamics, and the role that urban planning may potentially play in the achievement and maintenance of environmental quality.

Two major conclusions come out of the study. *First*, city characteristics such as size and level of manufacturing are important determinants of environmental pollution although the direct association between the two factors is weak. Study results indicated: air pollution levels increased with manufacturing concentration; water pollution problems were greater in more dispersed, lower-density urban regions; and suspended particulate concentrations were worst in the highly centralized cities where urban density gradients are relatively steep. *Second*, urban form and land use have important incremental effects, either increasing or decreasing environmental pollution. When city size and the level of manufacturing are held constant, the



Links between the urban economy, land use and environmental pollution

mix and pattern of land use control the nature, intensity and pattern of environmental pollution. For example, the *core-oriented urban region*, with a radial transportation network and steep density gradient, displays greater intensity of land use, a lower percentage of land developed and used for residential and commercial purposes, and more open space. As a consequence of this, land use mix and pattern, air and water quality are superior. On the other hand, the *dispersed urban region*, which has a less focused transport network and lower, more uniform population densities, displays urban sprawl and higher percentage of residential and commercial land use and less open space than in its core-oriented counterpart, resulting in inferior air and water quality. Berry's study showed that the critical factor was land use rather than city characteristics or urban form. The diagram summarizes the links between the urban economy, land use and environmental protection.

Source: Brian J.L. Berry, et al., *Land Use, Urban Form and Environmental Quality*, University of Chicago, Dept. of Geography (5828 S. University Ave., Chicago, IL. 60637), Research Paper No. 155, 1974. Paperback, 440 pp. $5.00.

Case Study 57
Urban Feasibility Studies in British Columbia

Submitted by George Atamanenko, B.C. Agricultural Land Commission

The Resource Analysis Branch of B.C.'s Ministry of the Environment is actively engaged in providing earth sciences data for a number of studies involving urban development and the environment. Listed below are projects for which inventory teams have collected and analyzed land resource information:

1. *The Chilliwack Mountain – Ryder Lake Uplands Study*: agriculture/ urbanization, 1978. This study analyzes terrain, water, climate, outdoor recreation and visual resources. The study team presented the results to the municipal council and others in a day-long seminar and field trip. It is now up to the municipal planner and other local officials to use the data effectively in formulating an urban/rural land use strategy outside the Agricultural Land Reserve (see 4.1 Agriculture) in the Township of Chilliwack.
2. *Resource Analysis for Urban Suitability, Vancouver North Shore Area*: urban development, 1977. To the data provided in the Chilliwack study, this project adds bedrock characteristics and standards and costs for hillside developments.
3. *Bowen Island Resource Analysis for Land Use Planning*: recreational/ residential/ water relationship of an island in close proximity to a large metropolitan area, 1978. This study adds, to the Chilliwack format, vegetation and slope analyses.
4. *Resources Inventory and Interpretation for Urban Development and Transportation Requirements, Southeast Kootenay Area*: resource orientation/large-scale coal development, 1977. In addition to the Chilliwack data this study covers wildlife capability (ungulates) and vegetation.

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Case Study 58
Environmental Planning, Mont St. Bruno, Quebec

Submitted by Lawrence Zimmering, André Marsan & Associates

The need for a physical planning process which fully integrates ecological concerns was recognized in the case of a proposed housing development for the diverse environment of Mont St. Bruno. Environmental consultants were engaged to perform a detailed ecological analysis of the site and to provide continuous input throughout the physical planning phase.

Following consideration of the general environment of Mont St. Bruno and identification of the nature of environmental impacts to be expected from development, the site was divided into ecologically homogeneous zones which posed development opportunities and constraints. These areas were further divided into 29 sub-units, with specific design and evaluation criteria. Relative development suitability indices for each sub-unit were established to integrate concerns about slope, drainage, erosion potential, vegetation composition, ecological sensitivity and impact-induction capability of the site. Specific recommendations were then made on development location and intensity, roadway design, construction procedures and re-establishment of vegetation cover. Special consideration was given to the maintenance of three freshwater lakes, considered highly sensitive to development, and other areas of hydrological importance (e.g. aquifer recharge). The study's holistic approach contrasts with linear approaches which simply combine the developmental opportunities and constraints of individual environmental components.

Although the study process was considered successful from both ecology and physical planning viewpoints, the project did not proceed. The provincial government expropriated the area to create a regional park.

Refer to:
André Marsan & Associates, *Mont St. Bruno, Ecological Planning and Assessment of a Proposed Housing Development*, 1975.

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Case Study 59
Site Selection: A Resource Town in B.C.'s Northeast Coal Block
Submitted by Ray Crook, Environment and Land Use Committee Secretariat

The British Columbia Government, in order to facilitate coal development by several private companies in largely uninhabited areas in the northeast, is considering the development of a new resource town with a potential population of around 10 000. In 1976 the Province's interagency Townsite/Community Development Sub-committee on Northeast Coal Development selected three possible sites for town development based on four preliminary site evaluation criteria: 1. commuting distance to mine sites; 2. accessibility to transport routes; 3. availability of developable land; and 4. local climate. The sites were named Tumbler Ridge (see Case Study 85 in 5.4 Plans), Bullmoose and West Flatbed. The latter was dropped from consideration when field studies revealed unsuitable soils.

Extensive investigation of the Tumbler Ridge and Bullmoose sites by the Environment and Land Use Sub-committee on Northeast Coal Development determined that environmental impacts at Tumbler Ridge would be much greater than at Bullmoose, and that even with careful planning the result could be degradation of fishery, wildlife, outdoor recreation and high-quality aesthetic resources. Bullmoose involved some impacts on moderate-capability fisheries. On the other hand, opportunities for town residents to take advantage of natural resources would be much higher at Tumbler Ridge than at Bullmoose which offered a relatively unattractive living environment. Climatically, the two sites were shown to be similar and both had ample land suitable for urban development. Bullmoose would present more severe water supply and sewage disposal problems, while road and rail access to Tumbler Ridge would create greater environmental impacts.

The Tumbler Ridge Townsite was approved in principle by the five Ministers on the Cabinet Coal Committee primarily because it offered the optimal commuting links to most mines and was best located for transportation purposes. The environmental analysis, however, identified the environmental planning issues well in advance of development. Considerable effort will be expended in environmental design if the town development proceeds.

Refer to:
Thompson, Berwick, Pratt & Partners, *Conceptual Plan, Tumbler Ridge, Northeast Sector, B.C.: A Physical/Social Plan/Financial Plan/Organizational Plan* (B.C. Ministry of Municipal Affairs and Housing, March 1978). Available from Planning Services, B.C. Ministry of Municipal Affairs and Housing (Parliament Buildings, Victoria V8W 3E1). See 5.4 Plans.

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Information Resources

See also:
1.2 Characteristics of Environmental Problems
2.7 Natural Environments and Human Activities
2.7 Energy
3.7 The Rural-Urban Fringe
5.4 Plans
5.7 Regulation and Review

Bascom, S.E. et al. *Secondary Impacts of Transportation and Wastewater Investments: Review and Bibliography. Secondary Impacts of Transportation and Wastewater Investments: Research Results.* Washington, DC: U.S. Dept. of the Interior and U.S. Environmental Protection Agency, 1975. 2 volumes. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402).

Annotated in 4.5 Transportation.

Berry, Brian J.L. *The Human Consequences of Urbanization.* London: Macmillan, 1974. Paperback, 205 pp. $5.95.

Bettison, David, G. *The Politics Of Canadian Urban Development.* Edmonton: University of Alberta Press, 1975. Paperback, 337 pp. $7.00.

Published for the Human Resources Council of Alberta, and the first of two volumes (the second is Human Affairs in Alberta), this book discusses the evolution of federal policy on regional economic development, housing, municipal development and urban renewal together with directions for national urban policy.

Bish, Robert L. and Nourse, Hugh O. *Urban Economics and Policy Analysis.* New York: McGraw-Hill, 1975. Hardcover, 435 pp. $17.40.

Urbanization and urban problems are approached comprehensively from an economic perspective. Environmental issues are covered in Chapter 2, primarily as pollution.

Bureau of Municipal Research. *Legislative Attempts to Control Urban Growth in Canada.* Toronto: BMR, November 1976. $4.00.

Seven categories of legislation were examined: height limitation downtown, planned unit development bylaw, limited residential growth in certain areas, no growth on periphery of town, moratorium on water and sewerage extensions, limitations on building permits, and tax incentives to development. For the 21 metropolitan centres surveyed, the latter three categories have not been used significantly. Although there was no consensus among the survey respondents that growth was a problem, approximately 55 pieces of legislation have been introduced in the 21 cities. Most of the cities based the need for growth management on consultant studies and planning reports which indicated that municipal services were being strained or the environment endangered. Despite this, several cities were confronted with legal challenges to their growth management legislation. The report covers the growth control approaches and experiences for each of the 21 cities; Vancouver and Toronto are examined in greater depth. Further annotated in 5.7 Regulation and Review.

Canada. Ministry of State for Urban Affairs. *Urban Indicators: Quality of Life Comparisons for Canadian Cities.* Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), 1976. 86 pp.

Clawson, Marion and Hall, Peter. *Planning and Urban Growth: An Anglo-American Comparison.* Baltimore: Johns Hopkins Press, 1974. Hardcover, $17.50.

Coughlin, Robert E. et al. *Stream Quality Preservation through Planned Urban Development.* Washington, DC: U.S. Environmental Protection Agency, May 1973. Available from National Technical Information Service (5285 Port Royal Road, Springfield, VA 22161), PB-222-177, $8.00.

Annotated in 3.1 Streams and Valleys.

Feldman, Lionel D. and Goldrick, Michael D. (eds.). *Politics and Government of Urban Canada: Selected Readings.* 3rd Edition. Toronto: Methuen, 1976. Paperback, 448 pp.

Readings cover theory, urban setting and influence, cities in an intergovernmental setting, structure, and urban and regional reform.

Gertler, Len and Crowley, Ron. *Changing Canadian Cities: The Next 25 Years.* Toronto: McClelland and Stewart, 1976. Paperback, 474 pp. $8.95.

Communicates the findings of a major research project in the Ministry of State for Urban Affairs. Examines Canada's demographic prospects; national patterns and regional diversities within the Canadian urban system; alternative urban patterns (case studies of Vancouver, Saint John and the Peace River region); the quality of the urban and metropolitan environment (as distinct from the quality of urban life) also with case studies and comparisons along selected urban indicators as well as the environment of outlying resource communities; the urban fringe/shadow/field; the human condition in urban areas; and forms of settlement, towards the "open city".

Gil, Efrain. *Energy-Efficient Planning : An Annotated Bibliography.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL. 60637), P.A.S. Report No. 315, March 1976. 23 pp. $6.00.
An overview of then-current approaches to energy-efficient land use planning and development control.

Gleeson, Michael E. et al. *Urban Management Systems: An Evaluation of Policy-Related Research.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL. 60637), P.A.S. No. 309, 310, August 1975. $12.00.

Annotated in 5.1 Environmental Planning in a Management Framework.

Hodge, Gerald. *Planning for Small Communities.* Toronto: Ontario Planning Act Review Committee, 1977. 17 pp. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $0.50.

Jaakson, Reiner, "Urbanization and Natural Environments: A Position Paper", *Urban Ecology,* 2 (1976), pp. 245-257.

Urbanization, identified as possibly the main catalyst for stresses imposed on natural environments by man, is seen as more than just city and suburban growth; rather, it is the process of change from rural to urban in favour of the latter. Such a concept forces consideration of the interdependency of rural and urban. Urbanization occurs both as growth in an urban settlement itself and in "colonies". Environmental stress is the problem, caused by concentrated population growth and consumption of resources. There are four kinds of effects: primary, the direct observable effects such as air and water pollution but also climate, wildlife, vegetation, etc.; secondary, which result from loss of population in rural areas; tertiary, stemming from the multitude of needs for sustenance of an urban system (energy, food and other resources, goods and services, wastes); and quartenary or catalyst, effects that result from urbanization's role as molder of attitudes, values and behaviour, and underlying the entire man-nature relationship.

Jameson, David, L. *Ecosystem Impacts of Urbanization Assessment*

Methodology. U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory (200 S.W. 35th Street, Corvallis, Ore. 97330), EPA 600/3-76-078, 1976.

This report reviews the ecosystem models developed by the International Biological Program and attempts to determine their usefulness in predicting the ecological effects associated with urbanization. IBP developed three levels of ecosystem models. The first was *Ecosystem Submodels or Component Process Models*, focused on ecosystem metabolism, i.e., the means by which structural characteristics and system properties control energy flow, nutrient cycling, and responses to perturbations. These models included abiotic, terrestrial primary production, terrestrial secondary production, terrestrial decomposition, terrestrial nutrient cycling, hydrology, aquatic primary production, aquatic decomposition, and aquatic nutrients. The second category was *Ecosystem Level Models*, combining individual biological, chemical and physical processes into models which characterize the entire ecosystem. These included specific ecosystem models (e.g. stream subsystem), applied models (e.g. DDT transport) and an atrophic interaction model. The third level was *Large Scale System Modeling*, combining eco-system models into a landscape-level or regional ecological model. The main conclusion of the report is that there is no model at this time, no matter how sophisticated, that could be used to predict the ecosystem effects of urbanization. There are, however, models which are useful in predicting specific effects from specific perturbations.

Kaiser, Edward J. et al. *Promoting Environmental Quality Through Urban Planning and Controls.* Washington, DC: U.S. Environmental Protection Agency, EPA – Gov/5-73-015, 1974. 441 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $4.25 + 25% outside USA.

Annotated in 1.3 Characteristics of Environmental Planning.

Kelly, Frank (ed.). *Population Growth and Urban Problems.* Science Council of Canada (150 Kent St. Ottawa, K1P 5P4), 1975.

This report: presents a compendium of statistical and other data which bear on the present and future size of Canadian cities and their physical, economic and social characteristics; assembles the many differing viewpoints of the growth of these cities; and summarizes expert analyses of the problems that lie ahead for cities and the main recommendations that have been put forward.

Keyes, Dale L. *Land Development and the Natural Environment: Estimating Impacts.* The Urban Institute (2100 M St. NW, Washington, DC 20037), 1976. 128 pp. $4.95.

Annotated in 2.2 Air Quality, 2.3 Water Quality and 5.5 Environmental Impact Assessment. See also: Kathleen Christensen, *Social Impacts of Land Development*, The Urban Institute, 1976. $3.95.

Lithwick, N.H. *Urban Canada: Problems and Prospects.* Ottawa: Information Canada, 1970. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9). $2.00.

Lorimer, James and Ross, Evelyn (eds.). *The City Book: The Planning and Politics of Canada's Cities.* Toronto: James Lorimer and Co., 1976. Paperback, 223 pp.

Drawn from *City Magazine*, the articles in this book cover land, city politics, planning, policies, and case studies of public and private development. See also, by the same authors and publisher: *The Second City Book: Studies of Urban and Suburban Canada*, 1977, 180 pp., $5.95, which has articles on land and suburbs, demolition, developers and city politics, planners and bureaucrats.

McAllister, Donald M. (ed.). *Environment: A New Focus for Land-Use Planning.* Washington, DC: National Science Foundation, 1973. Paperback, 328 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Catalog No. NS1.2:EN8, $3.75 + 25% outside U.S.A.

Most of the papers in this book are oriented to the urban environment. Further annotated in 5.4 Plans.

New Jersey, Department of Community Affairs, Division of State and Regional Planning. *Secondary Impact of Regional Sewerage Systems.* The Division (329 West State St., Trenton, NJ 08625), 1975. 88 pp.

This study notes that sewerage planning process takes inadequate account of long-range developmental impacts of trunk sewer construction; the local land use planning process is seldom sufficiently advanced to use sewer planning as a phasing tool to guide development; in unsewered areas the promise of sewers can change the whole basis of existing master plans, zoning, population prediction and real estate sales and areas with new sewers, combined with inadequate land use planning and controls, are vulnerable to future degradation. These and similar observations motivated this study, identifying the types of secondary impacts that may occur, presents case studies, reviews state and federal water management programs, and suggests new methods for assessing, managing and controlling negative secondary impacts. See also: New Jersey Dept. of Environmental Protection, *Enviromental Guidelines for Planning and Constructing Interceptor Sewers*, The Department (P.O. Box 2809, Trenton, NJ 08625), 1977.

Planning Environment International. *Interim Guide for Enviromental Assessment.* Washington, DC: U.S. Dept. of Housing and Urban Development, 1975. Binder, 300 + pages. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $20.00 + 25% outside U.S.A.

Field office manual for reviewing environmental impacts of development projects involving HUD. Annotated in 5.5 Environmental Impact Assessment.

Real Estate Research Corporation. *The Costs of Sprawl: Environmental And Economic Costs of Alternative Residential Development Patterns at the Urban Fringe.* Washington, DC: Council on Environmental Quality, Department of Housing and Urban Development, and U.S. Enviromental Protection Agency, April 1974. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Catalogue No. PREX 14.2:SP T/2, $3.45 + 25% outside U.S.A.

The major conclusion of this study is that for a subdivision with a fixed number of households, "sprawl" is the most expensive form of residential development in terms of economics, environmental costs, natural resource consumption and personal costs. The environmental advantages of planned development compared to sprawl include: potentially 20-30% less air pollution resulting from reduced automobile travel; more conservation of open space and preservation of significant wildlife and vegetation habitats; and, if properly designed, less storm runoff and minimal noise impact. Density is an important variable. Economic and environmental costs as well as resource consumption are likely to be much less at higher densities. Some personal costs, however, may increase with increasing density, and while higher density reduces total environmental costs, it increases the concentration of pollution.

Science Council of Canda. *Population, Technology and Resources.* Ottawa: The Council, Report No. 25, July 1976. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $2.50.

Simmons, James and Robert. *Urban Canada.* 2nd Edition. Toronto: Copp Clark, 1974. 188 pp.

Describes the historical development of urban areas, economic interrelationships, planning and administration, patterns of land use, functional and demographic distribution in the city, and policy making.

Townsite/Community Development Subcommittee on Northeast Coal Development. *Northeast Coal Study – Preliminary Feasibility Report on Townsite/Community Development.* Feb. 1977. 117 pp. Available from Queen's Printer of British Columbia (Parliament Buildings, Victoria, B.C.).

In 1976 a multidepartmental subcommittee in the B.C. government was assigned the task of selecting a suitable site for new town development in the Northwest B.C. Coal Block. Its report covers: potential coal development; work force estimates of residential land and housing needs; a detailed examination of two sites with respect to commuting distances and costs, potential regional transport networks, terrain suitability, environmental sensitivities, resource opportunities, water supply and sewage disposal; and a cost analysis. See also 5.4 Plans.

University of Guelph, Centre for Resources Development. *Hanlon Creek Ecological Study.* City of Guelph, Dept. of Planning and Development (City Hall, 59 Carden St., Guelph, Ont. N1H 3A1), 1971 and 1972. 2 Volumes.

Describes a study to determine how new residential development could be made compatible with a valued natural environment. Annotated in 3.1 Streams and Valleys.

U.S. Department of Housing and Urban Development. *Final Environmental Statement, Proposed New Community of San Antonio Ranch, Bexar County, Texas.* Washington, DC: HUD, 1972. 206 pp. Available from National Technical Information Service (5285 Port Royal Rd, Springfield, VA 22161), PB-202 588-F, $7.75.

Concludes that the project (a 9 318-acre site, 20 miles from San Antonio, planned for an ultimate population of 88 000) will result in greater protection and enhancement of the environment than the normal sprawl that would likely occur in the absence of planned community development. The statement describes the project fully and analyzes its environmental consequences, including unavoidable adverse effects and alternatives to the project.

Urban Systems Research Engineering, Inc. *The Growth Shapers: The Land Use Impacts of Infrastructure Investments.* Washington, DC: Council on Environmental Quality, 1976. 71 pp. Available from U.S. Government Printing Office (Supt. of Documents Washington, DC 20402), Stock No. 041-011-00029-7, $1.30 + 25% outside U.S.A.

This report explains and helps analyze the major role that certain public facilities – particularly highways, mass transit, sewers and various other "infrastructure investments" – play in the process of urban development. They affect local growth by influencing the location and costs of new construction and can have a powerful effect on the density, rate (extremely important), timing and amount of new development. Conversely, the careful design and construction of such infrastructure can help achieve well organized, environmentally sound urban growth. The problem is that infrastructure planners do not usually consider the land use effects of their facilities, with the result that land use changes are unplanned often accompanied by major adverse economic and environmental effects.

Voorhees, Alan M. and Associates Inc. and Ryekman, Ederley, Tomlinson and Associates. *A Guide for Reducing Air Pollution Through Urban Planning.* U.S. Environmental Protection Agency, Office of Air Programs (Washington, DC 20460), 1971.

Voorhees examined the implications of highway planning for air pollution control. The study experimented with eight different urban patterns (sprawl; moderate, heavy, rotated and extremely rotated corridors; centralized employment with either sprawling or radial population; and satellite cities), four highway networks (a basic arterial grid, freeways with an outer beltway and inner loop, additional radials and an inner beltway) and three basic transit networks (bus, rapid rail with bus, radial and outer loop rail). The goals for transport network design that were selected to promote improved air quality included: reducing trip lengths and automobile travel; moving traffic faster and at more consistent speeds; promoting expanded transit usage; and preventing increased traffic flows into already congested areas. Voorhees recommended some techniques to improve traffic flow, reduce pollution concentrations and reduce auto traffic.

Wiesman, Brahm, "A New Agenda For Our Cities", in Oberlander, H. Peter (ed.). *Canada: An Urban Agenda.* Community Planning Press (425 Gloucester St., Ottawa K1R 5E9), 1976. Paperback, 234 pp. $7.00.

Williams, E.R. and House, P. *The State of the System (SOS) Model: Measuring Growth Limitations Using Ecological Concepts.* U.S. Environmental Protection Agency, Office of Research and Development (Washington, DC 20460), Feb. 1974.

The State of the System Model is being developed as a technique for integrating the growth objectives of a region with the carrying capacity of the locale's resources. The model is in the early stages of development; at this point it should be considered as only a conceptual research tool. When completed, SOS model could be used to analyze three types of questions: 1. the ability of present growth trends to achieve the goals of the locale; 2. the probable life of a system operating within the constraints; and 3. the effects of different policy alternatives as starting points or adjustment mechanisms. The model consists of four elements: system inputs (e.g. total regional funds, population size, age distribution, quality of life demands), system outputs (demographic and economic characterization), state of the system (resource utilization environmental quality, satisfaction of quality of life demands) and system adjustments (policy options).

Wolman, Abel, "The Metabolism of Cities", *Scientific American,* Vol. 213, No. 3, 1965, p. 179-190.

4.3 Solid and Hazardous Wastes

Solid waste management used to be relatively straightforward. Sanitation was the main objective. Effectiveness was measured in terms of the control of disease-bearing organisms at collection, storage and disposal sites. The main environmental problem was air pollution from incinerator emissions.

Although public health is an equally important issue today, neither the objective nor the approach to managing solid waste is accepted to be that simple. Waste is no longer viewed as an inevitable by-product of economic growth. Attention is being given to reducing the amount of waste and recycling the remains. Meanwhile, the spectrum of adverse environmental effects associated with waste management has broadened considerably to encompass air and water pollution, safety hazard (methane gas explosions at London and Montreal garbage dumps, for example), odours, noise, the special problems of toxic wastes such as PCBs, and visual degradation. Public and political acceptability has become as important as technical feasibility in the search for environmentally acceptable disposal methods and sites.

Recent trends in both the amount and nature of solid waste have also made waste management more complicated and controversial.

The *volume* of solid waste residuals has increased substantially since the 1940s. Some projections show that the rate of waste generation is continuing to grow. Population growth is an obvious underlying factor; the Canadian population has doubled since 1940 and as more resources are consumed, more wastes are produced. But the reasons go deeper. "Waste" is culturally defined. People today discard things which they saved 30 years ago. Most of us enjoy a high-consumption lifestyle that feeds a material-intensive economy characterized by disregard for environmental effects that occur elsewhere and compounded by an approach to waste management that does not include all the costs.

At the same time, the *kinds* of wastes have changed (see 2.7 Natural Environments and Human Activities). Today's wastes include plastics, synthetics and other non-biodegradable products together with a myriad of toxic chemicals whose environmental effects are largely unknown (Case Study 61). In addition, there is radioactive waste, both high and low level, which presents formidable new problems (see 2.2 Radiation). Hazardous wastes, liquid as well as solid,

comprise only a small part of the total wastes dumped in the environment, but they are rapidly becoming a contentious public issue. Well and groundwater contamination, pollution of surface waters and air, fires, explosions, and direct-contact poisoning have, until recently, been the main concerns associated with the way in which these wastes are disposed of. Now cancer, genetic changes and concentration of toxic chemicals in food chains have been added to the list. Ironically, an important reason for the hazardous waste problem is the large concentrated quantities of sludges and residues produced by devices designed to remove air and water pollutants; for example, the 1976 Canada Water Year Book notes that sewage treatment plant effluents represent the major and most widespread source of PCB inputs to the environment. This interconnectedness between hazardous wastes and airborne/waterborne environmental control systems reveals the complex nature of the waste management problem.

For waste management to be effective, the diverse sources of solid and hazardous wastes and the specific problems associated with them have to be taken into account. *Agriculture* has traditionally been a major source of solid wastes from animals, slaughterhouses, crop harvesting, orchard prunings and related manufacturing operations. Changing from open grazing to feedlot production created a substantial waste management problem – what to do with the tons of manure produced in the feedlots. If disposal is inadequate, runoff from feedlots can contaminate the water supply of nearby municipalities. *Mining* extraction and processing operations result in slag heaps and mill tailings (uranium mines are of special concern). In 1974 it was reported that 80% of the total mineral solid wastes in the U.S. could be attributed to only eight of the 80 mineral industries: copper, iron and steel, bituminous coal, phosphate rock, lead, zinc, alumina and anthracite. *Industrial* solid and hazardous wastes are difficult to specify because of the lack of dependable information on quantities and qualities of their residuals. Generally, the main categories of solid wastes include scrap metal, paper products, plastics and fly ash. Slag, which used to present quite a disposal problem for steel mills, is now a valued by-product. Work is just beginning in Canada to classify and inventory toxic wastes in the industrial sector. *Residential, commercial* and *institutional* sources make up only a small part of the total solid waste load. They include such items as paper products, plastics, glass, cans, food waste, yard waste, abandoned automobiles, debris and sewage sludge. Disposal of leftover solids from municipal sewage and wastewater treatment plants is a serious problem because of the potential concentrations of pathogenic organisms and toxic chemicals in the sludge. The problem will probably be compounded as plans for secondary and tertiary treatment facilities are implemented and more sludge is produced. Industrial and urban solid wastes present the most direct threat to health and the urban environment and so they are prime targets for waste-disposal strategies.

Acknowledgements 4.3

This section includes contributions from:

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Table 4.3 Solid Waste Disposal Methods

Method	Advantages	Disadvantages
Open dumps	Easy, inexpensive.	Can lead to contamination of groundwater and nearby surface waters. Open to insects and rodents. Attract wildlife. Create foul odours. Waste land. Unsightly. Can create air pollution if garbage is burned at the dump site. Public opposition.
Sanitary landfill: direct disposal	Low cost. Easy to manage. Nuisance free; seals in odour. May be used to reclaim marginal land. Can receive most types of waste. Eliminates the need for waste separation	Land-intensive. Leachate may create water pollution and other health hazards. Production of methane gas can constitute a fire or explosion hazard. Difficult to find locations because of citizen opposition.
Sanitary landfill: disposal of processed waste	Shredding and baling reduces the volume of waste and extends the life of the landfill site. May reduce potential for water pollution. Minimum settling after use.	
Incineration	Reduces volume of urban waste by 90%. Modest land requirements. Waste energy produced may be usable for district heating.	High cost. Much of solid waste not accepted at incinerators. Some potential for smoke, fly ash and odour. Some kinds of wastes, such as plastics, can damage equipment. Requires skilled operators. Recent public concern over "hidden" pollutants such as PCBs.

Current waste disposal practices vary considerably in their effectiveness and their associated environmental impacts as Table 4.3 indicates. Generally, hazardous wastes are not handled very effectively. Often they are simply put in containers and dropped into municipal landfills or dumped directly into municipal sewers. The technology for environmentally sound treatment, storage and disposal of hazardous waste is available but there seems to be little economic incentive to use it. Newer methods cost 10 to 40 times as much as current methods.

So far, solid waste management has focused almost exclusively on waste disposal – remove it, burn it and bury it. Largely as the result of increasing energy and material costs, alternative approaches, resource recovery and waste reduction are slowly edging their way into current practice. Resource recovery includes *recycling* (reprocessing waste to recover raw materials), *material conversion* (making use of the waste in a different form, such as compost from waste-paper or low-grade fertilizer from sludge) and *energy recovery* (capturing the heat value from waste by burning it directly or converting it to a fuel product such as methane gas). Waste reduction involves minimizing the quantity of waste through means such as designing more durable products, restricting disposable throwaway products, putting limits on product packaging, and promoting consumption habits which are less material-intensive. Although both alternatives are attractive potential solutions to the high waste-generation dilemma, it will be some time before they figure prominently as strategies for waste management. Present market arrangements do not fully reflect all external costs of waste disposal and, as a result, resource recovery and waste reduction are not as yet "competitive".

This raises a special and urgent feature of the solid and hazardous waste problem. In recent years people have become more concerned about and more protective of environmental quality. Yet waste continues to be created at unprecedented levels. Pressure is exerted on governments and industry to tighten up regulatory processes, discontinue what are perceived to be hazardous practices, and dispose of wastes in an environmentally safe and sound manner – but not in my backyard. The results of this dilemma are increasingly evident. Municipalities are running out of places to dispose of their solid wastes

and they are unable to find satisfactory locations for new facilities. Industries are continuing to produce toxic liquid wastes in increasing quantities but, faced with closure of easily accessible landfill operations and unwilling or unable to bear the costs of transport to distant sites, trucking firms are simply dumping their loads into ditches, vacant lots and sewers (i.e. eventually into watercourses). Such activities cannot continue long. But, it is uncertain whether the outcome will be relaxed environmental standards, new disposal facilities negotiated with or forced upon unwilling communities, basic changes to reduce the amount of waste and change its nature, or some combination thereof.

Case Study 60
Ontario Environmental Assessment Board Rejects Maple Dump

The Ontario Environmental Assessment Board, after lengthy hearings, rejected two applications to create a sanitary landfill operation on 600 acres of worked-out gravel pits in the village of Maple, immediately north of Metro Toronto.

The proposed project would have provided a place to dispose of Metro's garbage over the next 30 years (Metro must find new landfill sites by 1982-83). But the Board was not satisfied that the proposed system of clay and plastic liners, coupled with purge wells to drain off liquids, was "sufficiently proven to achieve a fail-safe operation". There was also concern that the water table would fall, thus drying up wells, ponds and streams, and that further contamination to groundwater would occur. Trucks hauling garbage to the large dump would create heavy traffic, noise, vibration and dust with consequent "negative impact on the quality of life" of Maple residents, the Board feared. Finally, it concluded that a 30 year landfill operation was too long in light of expected improvements in resource-recovery technology.

The project was vigorously opposed by local residents, supported by the Canadian Environmental Law Association.

Refer to:
Environmental Assessment Board, *Hearing: Landfilling and Resource Recovery, Maple, Town of Vaughan*, Report on hearings from 6 July 1976 to 25 November 1977.

Richard Furness, "30-year plan for dumping Metro's garbage at Maple should be thrown out, board says", *Globe and Mail*, 22 April 1978, p. 4.

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Case Study 6l
Toxic Substances: The Most Difficult Environmental Problem Yet?

While knowledge of acute effects of various toxic chemicals is considerable and growing rapidly, knowledge of the chronic or long-term adverse effects of exposures to toxic substances is much less well developed. Latency (the period between exposure and manifestation of effect) and uncertainty (imperfect knowledge of the identity of toxic substances and the way they eventually affect health) make chronic toxic substances difficult to recognize and control. Yet toxic substances are receiving increased attention from regulatory agencies and environmental planners, primarily because of the sheer volume of publicity such substances now receive. That, in turn, largely reflects the fact that many of them are linked to cancer. Of the two million known chemical compounds, 30 000 of which are in substantial use, a growing number have been identified as carcinogens (e.g. arsenic, asbestos, benzene, chlorine, vinyl chloride, coal tar) and as many as 1 000 others are suspect. In addition, certain technologies involve considerable risk. An example is the dispersal of freon and other aerosol propellants by spray cans (deodorants, paint, hair conditioners, disinfectants, etc.) which have been shown to deplete the atmosphere's ozone layer.

Designing policies to respond to the threat posed by toxic substances, Portney argues, may be the single most difficult environmental problem ever encountered. This is so not only because of the peculiar characteristics of these problems but also because their solution may require significant, sometimes drastic, alterations in the conditions in which people work, the products they consume and the technologies they employ in their daily lives. The American Meat Institute, for example, claims that the U.S. Department of Agriculture's proposed reduction in the amount of sodium nitrite that can be used to cure bacon "has the potential for causing the closing of most or all bacon processing plants and destroying a multibillion-dollar industry". Economic forces have the potential to alleviate the need for corrective policy but

they are limited in this regard. Neither workers nor consumers have adequate information about the risks associated with jobs or products; there may be no alternatives to these jobs or products; and they may be unable, for financial or other reasons, to take advantage of the alternatives that do exist.

Governments have taking an increasingly active role (e.g. Canada's *Environmental Contaminants Act*, Statutes of Canada 1974-75, and the U.S. *Toxic Substances Control Act* of 1976, Public Law 94-469) usually employing a standards-regulation approach (by contrast, Britain relies on judgements based on "the best practicable means" with monitoring and measurements by a factory inspectorate). This raises additional problems, among them establishing acceptable enforceable exposure levels, attempting to assess the magnitude of specific risks in relation to the many different ordinary risks that we have to accept as a necessary part of life, sorting out the jurisdictional complexities, ensuring accountability of the agencies concerned, testing for the identity and potency of toxic substances, and (without creating panic) disseminating the information in terms readily understandable to those who could benefit from it.

Refer to:
Paul R. Portney, "Toxic Substance Policy and the Protection of Human Health", in Paul R. Portney (ed.), *Current Issues in U.S. Environmental Policy* (Baltimore: Johns Hopkins Press, 1978), paperback, 256 pp., $4.95.

Science Council of Canada, *Policies and Poisons: The Containment of Long-Term Hazard to Human Health in the Environment and in the Workplace* (Ottawa: Science Council of Canada, 1977), 76 pp. See Information Resources.

Information Resources

See also:
2.2 Radiation
2.7 Natural Environments and Human Activities
2.7 Energy

Aikin, A.M., Harrison, J.M. and Hare, F.K. *The Management of Canada's Nuclear Wastes.* Dept. of Energy, Mines and Resources (Ottawa K1A OE4), 1977. 63 pp.

Annotated in 2.2 Radiation and 4.7 Energy Projects (which lists additional sources on this subject).

Berry, Brian J.L. and Horton, Frank E. *Urban Environmental Management: Planning for Pollution Control.* Englewood Cliffs, NJ: Prentice-Hall, 1974. Hardcover, 425 pp. $14.95.

Chapter 9, "Solid-Wastes Management", covers the origin of solid wastes, their collection and disposal, multipurpose concepts in refuse disposal (recycling, land reclamation, etc.), and refuse disposal and groundwater pollution.

Castrilli, J.F. and Dines, A.J. *Control of Water Pollution Land Use Activities: An Evaluation of Legislative and Administrative Programs in Canada and the United States.* International Joint Commission (100 Ouellette Ave., Windsor, Ont. N9A 6T3), March 1978. 109 pp. Free.

Annotated in 2.3 Water Quality. One of the sets of land use activities covered is liquid, solid and deepwell waste disposal. The report (pp. 40-58) describes for the Great Lakes Basin, the institutional framework and regulatory programs relevant to these activities. Among the report's conclusions for Ontario: "regional plans are sometimes not sufficiently specific in forbidding certain land uses (e.g. waste disposal activities) in certain areas (e.g. environmentally sensitive); this deficiency, combined with antiquated local zoning, can defeat efforts to prevent a waste disposal facility from being located in a place where it may damage water quality". And "the large volumes of land-spreadable sludge that are generated by treatment plants and the small number of approved sites suggest that haulers are spreading or dumping sludge in environmentally inappropriate and unapproved areas". Also, the Province's policy on liquid industrial waste disposal, calling for reduction of toxic waste disposal in deepwells and sanitary landfills, is contradictory; since there are no deepwells, such wastes go in increasing quantities to sanitary landfills or to environmentally even less suitable areas.

Clarke, R.H. and Brown, J.H. *Municipal Waste Disposal: Problem or Opportunity?* Toronto: Ontario Economic Council, 1972. 176 pp. + app. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8). $3.00, cheque payable to Treasurer of Ontario.

Deals with sanitary landfill, incineration, composting, new processes, reclamation systems, value and utility of reclaimed materials, and collection. Conclusions and recommendations are presented.

Colonna, Robert A. and McLaren, Cynthia. *Decision-makers Guide to Solid Waste Management.* Washington, DC: U.S. Environmental Protection Agency, Office of Solid Waste Management Program, 1974. 157 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $1.95 + 25% outside U.S.A.

A good summary of the costs, benefits, and effectiveness of approaches to solid waste management. Covers all aspects of the waste management cycle including collection, transfer to stations, transportation to disposal sites, and sanitary landfill. A section on "special wastes" such as tires, waste lubricating oil

and sewage sludge documents some of the environmental problems that have resulted from improper waste disposal.

De Renzo, Dorothy. *Energy from Bioconversion of Waste Materials.* Noyes Data Corporation (Mill Road at Grand Ave., Park Ridge, NJ 07656), 1977. 223 pp. $32.00.

Describes practical arrangements and equipment, large and small, for the anaerobic decomposition of organic wastes to produce methane gas.

Energy, Mines and Resources Canada, Office of Energy Conservation. *The Garbage Book: How to Save Energy and Money by Throwing Out Less.* Conservation Books (P.O. Box 3500, Station C, Ottawa K1Y 4G1), 1977. 104 pp. Free.

Environment Canada, Waste Management Branch. *Solid Waste Management Information.* Environment Canada, Environmental Protection Service (Ottawa K1A 1C8), periodically updated. Free.

A useful listing of available materials and services. A similar but more extensive source from the United States is Lederer, below.

Fisheries and Environment Canada. Canada Water Year Book 1976. Supply and Services Canada (Printing and Publishing, Ottawa K1A OS9), Catalogue No. En36-425/1976, $3.50 ($4.20 outside Canada).

General Electric. *Solid Waste Management: Technology Assessment.* GE, Technology Marketing Operation (1 River Road, Bldg. 5, Dept. B, Schenectady, NY 12345), 1975. $450.00.

Golueke, Clarence G. *Biological Reclamation of Solid Wastes.* Rodale Books (33 E. Minor St., Emmaus, PA 18049), 1977. Paperbook, 272 pp. $5.95.

Goodard, Charles, "Hazardous Waste Disposal", *The Conservationist,* Vol. 32 No 4, Jan.-Feb. 1978.

A well-written summary of the hazardous waste disposal problem in New York State. (*The Conservationist* published by the New York State Department of Environmental Conservation). Goodard outlines seven possible waste management options: waste reduction (substituting less hazardous materials in manufacturing processes), waste separation, recycling, waste recovery, incineration, neutralization by acids and caustics, and land disposal.

Lederer, P. *Solid Waste Management. Available Information Materials. Interim Catalog.* Washington, DC: U.S. Environmental Protection Agency, December 1977. Free.

A comprehensive bibliography of reports, films and training programs produced and collected by the Office of Solid Waste, U.S. Environmental Protection Agency (Washington, DC 20460).

Love, Peter. *Net Energy Savings from Solid Waste Management Options (A Summary).* Environment Canada, Environmental Protection Service (Ottawa K1A 1C8), 1976. 27 pp. Free (quantity limited).

An essential difference among solid waste management systems is their treatment of the large paper component. This study reveals that in the majority of cases considered (for Southern Ontario), net energy savings are attributable to recycling waste paper rather than using it as a source of energy. Such recycling could also result in a net decrease in air and water pollution. Energy savings resulting from reduction at source options were assessed separately.

National Center for Resource Recovery, Inc. *Bibliography, Resource Recovery.* The Center (1211 Connecticut Ave. NW, Washington, DC 20036), n.d. 38 pp.

National Research Council, Commission on Natural Resources. *The Shallow Land Burial of Low-Level Radioactively Contaminated Solid Waste.* National Academy of Sciences (Printing and Publishing Office, 2101 Constitution Ave. NW, Washington, DC 20418), 1976. Paperback, 150 pp. $7.00.

Reviews a number of cases where radioactively contaminated waste was buried and recommends principles for dealing with it. Annotated further in 2.2 Radiation.

Nova Scotia College of Art and Design. *Lunenburg County Solid Waste Disposal Site Selection Study.* Municipality of the District of Lunenburg (Municipal Building, 210 Aberdeen Road, Bridgewater, N.S.), 1976. 89 pp.

This study, by environmental design students at the College (5163 Duke St., Halifax, N.S. B3J 2J6), aimed at assisting the rural municipality in finding a site that would satisfy economic, engineering and ecological requirements for disposal of solid waste generated by 40 000 people over the next 30 years. Site selection involved a numerical scoring technique that reflected five objectives (listed here in the order of importance determined by the municipal public works committee): public health and safety, physical and operational (cost), public acceptability, ecological considerations, and area planning and development concerns. A number of criteria were used to measure to what extent each site satisfied these objectives. Those considered most significant by the committee were water supply pollution potential, hydrogeologic capability, life of site, proximity to residences, availability of cover material, compatability with present land use, and present land ownership. The environmental conditions pertinent to each site were then identified and rated in terms of suitability for landfill and incineration; for example, under the criterion of avoiding surface water pollution, each alternative site had to be examined for the likelihood of stream and lake pollution should a disposal facility be located there. Finally, weighted objectives, weighted criteria and condition ratings were brought together and applied to yield site scores for each of the 14 potential sites which were subsequently examined using aerial photography with ground truthing. The best site was then identified and recommendations were made for a detailed engineering examination.

Pollution Probe Ottawa and Consumers Association of Canada. *Living Well in Times of Scarcity.* Pollution Probe Ottawa (53 Queen St., Suite 54, Ottawa K1P 5C5), 1978. 68 pp.

An activity book designed to make consumers more aware of the consequences of sloppy household practices (such as waste handling) vis-à-vis energy and resource consumption.

Resource Conservation and Recovery Act of 1976, Public Law 94-580, 94th U.S. Congress, 21 Oct. 1976. Available from U.S. Environmental Protection Agency, Office of Solid Waste Management (Washington, DC 20460).

The U.S. Government's new legislation was designed (a) to provide technical and financial assistance for the development of management plans and facilities for the recovery of energy and other resources from discarded materials and for the safe disposal of discarded materials, and (b) to regulate the management of hazardous waste.

Roche Associates Ltd. *Gestion des déchets du milieu médical et des services annexes.* Services de protection de l'Environnement (94 rue Paradis, Ste-Foy, Québec, Qué. G1V 2T6), Oct. 1977.

Report on the management of waste from medical facilities.

Rovers, F.A. and Sobanski, A.A. *Recommended Procedures for Landfill Monitoring Program Design and Implementation. Environment Canada, Environmental Protection Service, Environmental Impact Control Directorate (Ottawa K1A 1C8), EPS-4-EC-77-3, 1977. 25 pp. Free (quantity limited).*

This document discusses and recommends procedures for landfill monitoring program design and implementation. Also available from the E.P.S.: F.A. Rovers and J.J. Tremblay, *Procedures for Landfill Gas Monitoring and Control,* 1977.

Science Council of Canada. *Policies and Poisons: The Containment of Long-Term Hazardous Human Health in the Environment and in the Workplace.* Ottawa: Science Council of Canada, 1977. 76 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A OS9), Catalogue No. SS22-1977/28, $2.00 ($2.40 outside Canada).

A study of health hazards to which the Canadian public and workforce may be exposed, and of the decision-making processes designed to protect us against these hazards. Six are discussed in depth: lead, asbestos, radiation, vinyl chloride, mercury and oxides of nitrogen. The process of risk assessment (relating the hazard of exposure to the probability of exposures reaching certain levels), the determination of acceptable risk, medical record systems, regulation and occupational health are examined and recommendations are made. The principal recommendation is that a National Advisory Council on Occupational and Environmental Health be created by statute with a mandate (a) to designate hazards and ensure that assessment of risks associated with designated hazards are undertaken and published, and (b) to be responsible for publishing recommended standards of maximum permissible exposure levels for Canada.

4.4 Resource Development

Exploitation of natural resources – biophysical elements such as land, water, forests, fish, minerals and fuels, necessary for the production of certain essential commodities – has always been basic to Canada's economic and political development. The 1961, Resources For Tomorrow Conference marked a turning point, however, by emphasizing conservation and raising new environmental concerns. More recently, national attention has also focused on resource scarcity and northern development. Technological ingenuity and a considerable increase in the demand for services (as opposed to raw materials) have combined with these recent concerns to alter the economically oriented concept of resources. Greater emphasis is now placed on intangibles such as quality, ecological diversity and harmony. One response is the concept of multiple use, with compatibility not just among uses but also with the natural and human environments they affect, and its more recent variant "integrated resource management".

Solid Waste Task Force. *General Report of the Solid Waste Task Force to the Ontario Ministry of the Environment.* Toronto: Ministry of the Environment, 1974. 3 volumes. Available, at $2.00 per volume, from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), cheque payable to Treasurer of Ontario.

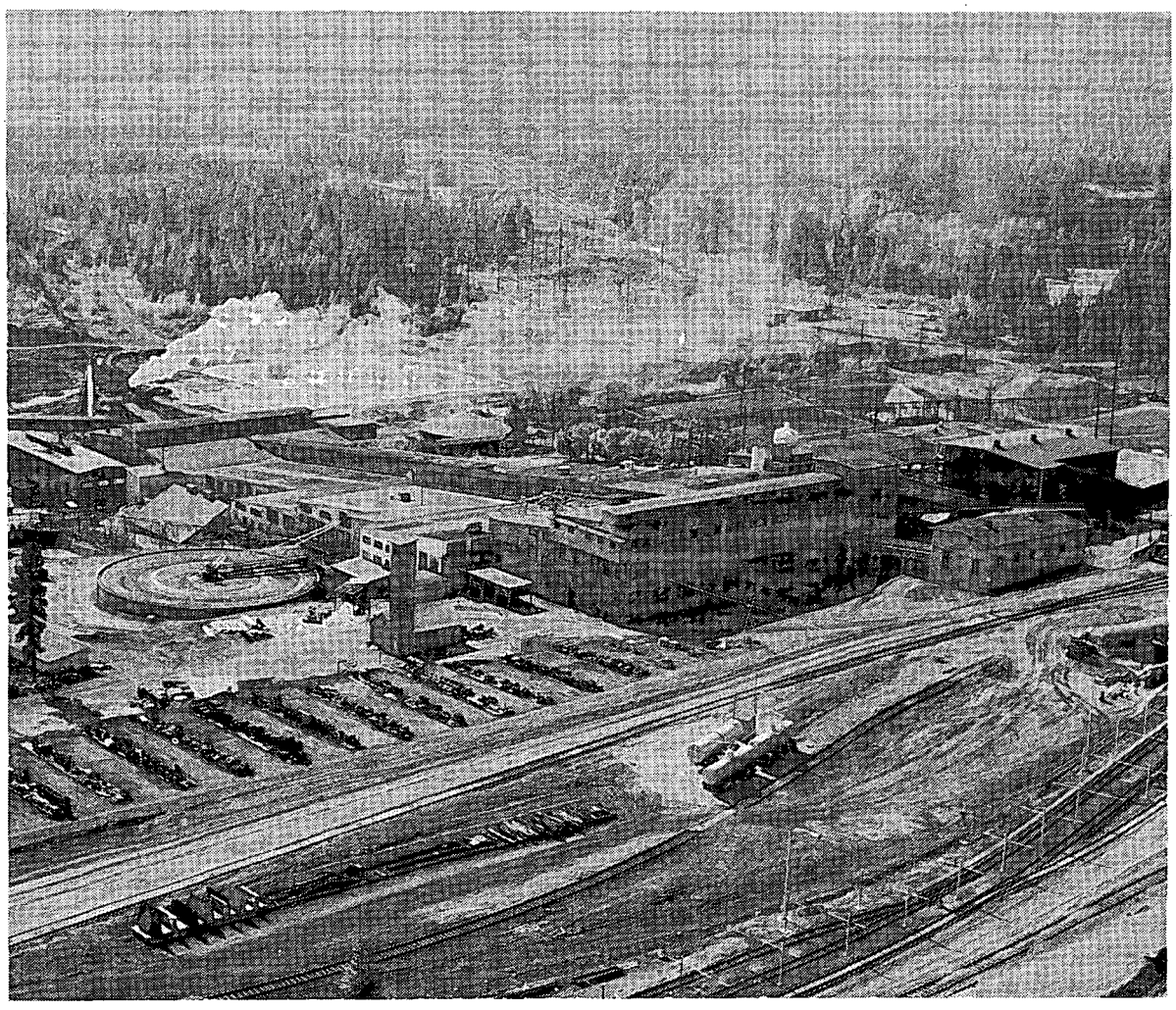
Volume 1 is a general report of the Task Force, the Beverage Packaging Working Group, and the Milk Packaging Working Group. Volume 2 is an environmental study of beverage packaging. Volume 3 is a statistical report.

U.S. Dept. of Health, Education and Welfare. *Basic Concepts of Human Health.* National Institute of Environmental Health Sciences (P.O. Box 12233, Research Triangle Park, NC 27709), 1977. 43 pp. Free. *Human Health and the Environment: Some Research Needs.* 1977. 498 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $1.92 + 25% outside U.S.A.

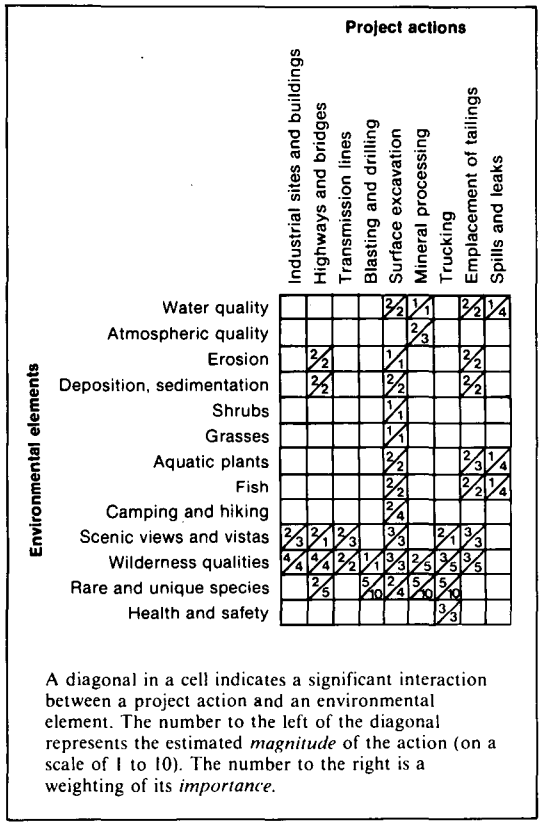
The first source summarizes the second. Both cover various aspects of environmental health including the effects on man of various chemicals and pollutants associated with solid and hazardous waste.

U.S. Environmental Protection Agency. *Resource Recovery and Waste Reduction.* Fourth Report to Congress. EPA (Washington, DC 20460), 1977. 140 pp. Free.

Reviews the municipal solid waste management problem and overviews U.S. federal, state and local developments in resource recovery and waste reduction. Focuses primarily on the programs and projects of the Agency.



The extent of resource development activities and their resultant environmental effects depend upon growth and distribution of population, standard of living, modes of production and consumption, and the vagaries of international trade. For example, population increase accompanied by increased demand for single-family housing leads to greater demand for forest products. Similarly, a change in a production activity (such as the displacement of farm labour and use of solar energy in agriculture by high-energy inputs dependent on fossil fuels) has substantially increased the demand for certain resources. As resources become scarcer, the activities necessary to develop them become more difficult and probably more environmentally destructive.



A diagonal in a cell indicates a significant interaction between a project action and an environmental element. The number to the left of the diagonal represents the estimated *magnitude* of the action (on a scale of 1 to 10). The number to the right is a weighting of its *importance*.

Figure 4.6 Sample Environmental Impact Assessment Matrix for a Proposed Mining Operation.

Source: Ronald Barbaro and Frank L. Cross, Jr., *Primer on Environmental Impact Statements* (Westport, CT: Technomic Press, 1973). Reproduced with permission.

Resource development includes:

- Identification of the resource (exploration, surveying, etc.)
- Preparation for its exploitation (e.g. building access roads, clearing and grubbing, erecting facilities, fertilizing the soil)
- Extraction of the resource (mining, for instance) or otherwise tapping its potential (e.g. sowing and harvesting)
- Disposal of associated wastes
- Transport of the derived raw materials to markets or to the next stage of processing
- Renewal of the resource, where appropriate (e.g. reforestation) and/or restoration of the site.

Traditionally the main natural resource development activities in Canada have been forestry, water power development, fuel and mineral extraction, agriculture, fishing and the fur trade. Economic and other benefits have been considerable but adverse environmental and social effects have also resulted. Familiar examples include: clearcutting in forests and habitat destruction by logging; acid wastes, unsightly and sometimes hazardous slag heaps and tailings, and devasted landscapes resulting from mining; loss of species through short-sighted harvesting practices in freshwater and marine fisheries; large areas flooded and people dislocated by major hydroelectric projects; huge quantities of sediment, nutrients and pollutants washed into lakes and streams from agricultural lands; oil spills; and so on. Furthermore, the closely related primary manufacturing stage, characterized by large-scale bulk refining and concentrated processing of raw materials, is particularly damaging to the environment. Pulp and paper mills, iron and steel operations including smelting and refining, petroleum refining and industrial chemical production create the highest order of environmental stress and demand a disproportionately large share of energy and other resource inputs to Canadian industry (Statistics Canada).

Increasingly the environmental consequences of resource exploitation and the distribution of these "costs" relative to the derived benefits are raising questions, generating conflicts and creating controversy, especially where the adverse effects are close at hand for a large number of people. Planning oriented to enhancing environmental capacity and quality has a potential role in reducing or mitigating these adverse effects. But the problem goes much deeper than that, in two ways.

Acknowledgements 4.4

This section includes contributions from:

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The first questions the long-term capacity of the natural environment to meet expanding human wants. Brubaker argues that only "two paths are open to man in order to secure permanent occupancy: 1. to aspire to a modest but sustainable place in the natural system by changing to a technology that is nondepleting in character; and 2. calculated effort to escape the constraints of resource exhaustion through new technologies". Conservation is an essential component of either strategy, he maintains. Necessary initiatives include more efficient transportation of the natural capital represented by resource stocks, protection of the sustainable productivity of the land and other renewable resources, extension of the life of non-renewables (more complete extraction, more efficient refining, reduced resource use per unit of output, etc.), substitution of renewables for non-renewables, recycling of materials, and sheer reduction of consumption.

The second basic concern is closely tied to the first. Appropriate national and provincial policies are needed to guide public and private actions affecting resource development. Current policies favour development of the use of virgin resources rather than measures to restrict use or consumption, certain uses are arbitrarily given preference, subsidies distort apparent returns from resource development, values and costs not registered in the marketplace receive less attention, and complex administrative arrangements frustrate integrated action. How to relate one kind of resource development to another rather than pursuing each sector more or less independently (something that is encouraged by departmental structures and key interests); how to identify and interpret short-term needs in a long-term context; deciding which resources are needed now, how much they are needed and by whom; determining whether they should be developed and under what conditions; how to weigh the tradeoffs between one resource and another - these and similar questions bear heavily on present and future environmental capacity and quality.

Case Study 62
The National Coal Policy Project

Environmental issues have often triggered a kind of warfare. Sides were sharply drawn, extreme positions were taken, and the industrialist and environmentalist camps proceeded down a destructive path on which both sides found their triumphs to be hollow; hastily contrived environmental measures built up public resistance and failed in court, and long delays strained corporate treasuries. The National Coal Policy Project was established in an effort to find an alternative, a more reasoned and mutually satisfying approach to the settlement of environmental disputes surrounding the increased development of coal resources. Over a year-long period approximately 60 participants – half from coal-mining and coal-using industries, half from environmentalist ranks – met in five separate task forces to try and agree on how and where coal should be mined and burned as well as how it should be transported, priced and conserved. Georgetown University's Center for Strategic and International Studies sponsored the project, provided backup support and organized a campaign to raise the $675 000 needed for expenses.

During the exercise, members on both sides found themselves backing away from previous positions, making concessions in order to secure gains, and recognizing certain common objectives which might provide the basis for workable compromises without overstatement, rancor and defensiveness. Largely responsible was the use of the "rule of reason" (taken from Milton Wessel's book of the same name) which replaced the usual adversary process.

Although difficulties obviously remain, the Project's multi-volume report (available from the Center, below) indicates that important solutions were found to complex problems. The approach, which has applicability to similar circumstances in other environmental sectors, appears to have struck a tolerable balance between social goals that have tended to be incompatible.

Refer to:

Tom Alexander, "A Promising Try at Environmental Detente for Coal", *Fortune*, 13 Feb. 1978, pp. 94-102.

Ken Small, *Coal, the Environment and the Rule of Reason* (Center for Strategic and International Studies, Georgetown University, Washington, DC, n.d.), $3.00.

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Case Study 63
Gravel Extraction in Central Nova Scotia
Submitted by Michael Simmons, Maritime Resource Management Service

Suburban development in central Nova Scotia has occurred immediately adjacent to expanding gravel pits. All of North River, a new community in Colchester County, is built on gravel terraces. Gravel is removed by river dredging and the use of draglines and bulldozers. In 1970 new residents protested against the noise, dust, hours of operation, traffic congestion and traffic/water-related safety hazards to children. Investigation showed that conflicts between gravel extraction and housing were widespread throughout the area (population 17 000, growing at 5% per year). There was no municipal development plan. Similar circumstances could be found in other parts of Nova Scotia.

Though most of the gravel deposits were unexpected, a few were of the highest quality. Urban development had already alienated over half the gravel from industrial extraction; most deposits would soon have been subdivided if present trends had continued. A report on the problem recommended creation of "gravel extraction reserves", rehabilitation requirements and regulation of the extraction process. Municipal Council endorsed a proposal to create a park at North River but voted no money for this purpose. Between 1971 and 1976 the provincial government: carried out a province-wide inventory of commercially acceptable gravel deposits; appointed a mining engineer, experienced in this field, to the Department of the Environment; designated an inspection engineer in the Department of Highways to ensure conformity of gravel operations with contract specifications, including provisions on aesthetics; and amended the Municipal Act to allow municipalities to pass bylaws regulating pits "not to be left in a state more unsightly than before they were opened".

In 1976 the Deputy Ministers Committee on Land Use Policy established an issue group to deal with aggregates. The group initiated cooperative action to prevent "North River" situations. All highway contracts are to stipulate requirements, the same as those under the Environmental Protection Act, for pits and quarries. Regulations of the Department of the Environment will only be applied to permanent pits, about 60 of Nova Scotia's total 6 500. The Nova Scotia Road Builders Association is to oversee the imposition of appropriate contract specifications and regulations.

Refer to:
M.D. Simmons, Gravel Extraction and Land Planning in Central Nova Scotia, Maritime Resource Management Service, 1971, $1.50.

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Case Study 64
A Resource Management Policy for Alberta's Eastern Slopes

The Eastern Slopes of Alberta's Rocky Mountains, encompassing approximately 90 000 km^2, possesses a wealth of renewable and non-renewable resources. Growing demands for resources and land use in the area have led to conflicts in land allocation and increased concern for protection of environmental quality in this region. Two planning studies in the early seventies initiated a comprehensive planning process designed to identify optimum resource uses for land units. Hearings conducted in 1973 by the Environmental Conservation Authority and a public opinion survey identified views and concerns of the Alberta public. In 1975 the Eastern Slopes Interdepartmental Planning Committee was established to make recommendations on an integrated resource planning approach and in July of that year the provincial government finalized a policy for management of the Eastern Slopes. Subsequently the Alberta Coal Development Policy (see Information Resources) classified all lands in the Eastern Slopes in terms of the extent to which coal exploitation and development activities would be permitted.

The Government identified integrated land use planning as the means of implementing its resource management policies for the Eastern Slopes. A land use zoning system allocates resources at the regional scale based on a combined evaluation of the physical environment, the existing resources, present land use, demand and the public interest. It directs integrated land management efforts towards maximizing the benefits derived from the region while minimizing resource conflicts and costs, and it provides guidance for detailed resource management planning and environmental controls. Underlying the zoning are certain designated priorities: the need for a comprehensive planning system; watershed management as top priority; maintenance of recreation potential and aesthetic quality; protection of critical wildlife habitats and other areas of natural significance; development and use of resources consistent with proper conservation and environmental protection; long-term priority given to management of non-renewable resources; service centre development associated with transportation modes; and retaining of Crown Land in public ownership. Three broad land use zones are designated and within them, eight detailed zones outline a range of permitted activities in keeping with stated priorities and management objectives of the zone:

Protection	1. Prime Protection
	2. Critical Wildlife
Resource Management	
	3. Special Use
	4. General Recreation
	5. Multiple Use
	6. Agriculture
Development	7. Industrial
	8. Facilities

Refer to:
Environment Council of Alberta, *A Policy of Resource Management of the Eastern Slopes* (Edmonton: Alberta Energy and Natural Resources, Resource Information Services, July 1977), 19 pp., $1.00.

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Information Resources

See also:
2.1 Land Use and Misuse
2.3 Water Quality
2.5 Forests
2.6 Wildlife and Fish
2.7 Natural Environments and Human Activities
4.7 Energy Projects

Alberta Dept. of Energy and Natural Resources. *A Coal Development Policy for Alberta.* Alberta Energy and Natural Resources (9915 – 108th St., Edmonton T5K 2C9), June 1976. 38 pp. + app.

The Alberta Government's statement of coal development policy, in four parts: an introduction that outlines the nature and importance of the province's coal resources; a general statement which summarizes the overall policy; elements of the policy in more detail; and administrative procedures which highlight the process of application, consideration and development applicable to specific coal development proposals.

Anders, G. et al. *The Impact of Taxation and Environmental Controls on the Ontario Mining Industry: A Pilot Study.* Toronto: Ministry of Natural Resources, n.d. 192 pp. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $3.00, cheque payable to Treasurer of Ontario.

Barr, John. *Delerict Britain.* Pelican, 1969. Paperback, 240 pp. $1.50.

An angry book that looks closely at Britain's industrial wastelands and examines what can and should be done to redeem them. In particular the author draws a detailed study of the Lower Swansea Valley, ravaged by centuries of industrial plundering and government indifference, and demonstrates how reclamation techniques planned there can be applied elsewhere. For a more recent statement see: Trevor Fishlock, "How Green is My Valley: In Wales, Mined Wastelands are Giving Way to New Fields and Forests", *International Wildlife*, Vol. 8, No. 2, March-April, 1978, pp. 51-54.

Baurer, Anthony M. *A Guide to Site Development and Rehabilitation of Pits and Quarries.* Toronto: Ontario Department of Mines, Industrial Miners Report No. 33, 1970. Paperback. 62 pp. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $1.25, cheque payable to Treasurer of Ontario.

B.C. Environment and Land Use Committee Secretariat. *Terrace-Hazelton Regional Forest Resources Study - Summary Report.* 1976. *Terrace-Hazelton Regional Forest Resources Study - Summary Report.* 1977. ELUC Secretariat (Parliament Buildings, Victoria V8V 1X4).

These two documents resulted from a case study of the relationship between timber in the Annual Allowable Cut (AAC) and timber which is more or less economically harvestable at present. The reports reflect an evolving method for evaluating the degrees of financial risk and opportunity confronting logging operations. "Logging acceptability" concepts suggest that an operator's costs are most heavily influenced by the quantity of timber harvested while revenues more closely reflect timber quality. Low-risk logging is most probable, given uniform timber and terrain, long operating season, high wood quality and low wood defect. As uniformity declines the optimal logging system becomes more complex and more difficult to implement. In the Terrace-Hazelton area, some timber in the AAC is economically inaccessible; unrealistic AACs appear to have led to "high grading" of the economically accessible areas. Consequently, economic timber volumes are declining even though, in a biophysical sense, management could be termed "sustained yield".

Beckerstaff, A. (ed.). *Multiple Use of Forest Land in Canada: A Collection of Summary Statements Provided by Provincial and Federal Agencies.* Ottawa: Canadian Forestry Service, Department of Fisheries and Forestry, Forest Management Institute, Information Report FMR-X-20, 1969. 30 pp. Contact Environment Canada, Canadian Forestry Directorate (Ottawa K1A OH3).

Increased pressures for recreational camping, preservation of aesthetic values, wildlife habitat management and watershed management have induced governments to consider multiple use of their forests (the primary use being timber harvesting). This report outlines the policies and practices of the provincial and federal governments with respect to forest lands. One conclusion drawn is that areas managed directly by the Crown (such as provincial parks where logging is permitted) are better examples of multiple use than areas managed privately for timber operations (such as Crown land leased to logging companies).

Boccardy, Joseph A. and Spaulding, Willard M., Jr. *Effects of Surface Mining on Fish and Wildlife in Appalachia.* Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service, 1968. Paperback, 20 pp. Available from the U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $0.35 + 25% outside U.S.A.

Brooks, David B. *Resource Economics: Selected Works of Orris C. Herfindahl.* Baltimore: Johns Hopkins University Press, 1974. Hardcover, 316 pp. $16.00.

Economic theory is applied to exhaustible resources depletion, exploration strategy and other topics in this Resources for the Future Study. It includes a chapter on the effects of resource depletion and economic growth on the quality of life.

Brubaker, Sterling. *In Command of Tomorrow: Resource and Environmental Studies for Americans.* Baltimore: Johns Hopkins University Press, 1975. Hardcover, 177 pp. $7.95.

A Resources for the Future Study which covers resource imperatives and social goals, issues in land use policies, settlement patterns and the implication of resources, energy alternatives for the United States, dilemmas for mineral policy, abatement of pollution in a growing economy, resources and international responsibility, and a summary of policy choices and their implementation.

Burton, Thomas J. *Natural Resource Policy in Canada: Issues and Perspectives.* Toronto: McClelland and Stewart, 1972. Paperback, 174 pp. $3.50.

Overviews natural resource policy issues in Canada. Chapters cover the historical perspective, natural resources and economic growth, Canadian resources and international relations, the constitutional setting, party political themes, the environmental conscience, and the author's personal view.

Canada. Dept. of Industry, Trade and Commerce. *Sector Task Force on the Canadian Forestry Industry.* The Dept. (Ottawa K1A OH5), 1978.

This report discusses the impact of government fiscal policies (taxation, pollution control, energy conservation, research spending, etc.) on the forestry industry.

Clark, B.D. et al. *Assessment of Major Industrial Applications: A Manual.* Scottish Development Dept. (New St. Andrew's House, Edinburgh, Scotland), 1976. 170 pp. £2.

Annotated in 5.5 Environmental Impact Assessment.

Coates, W.F., "Can Surface Mining be Compatible with Urbanization?", *CIM Bulletin*, November 1975.

Conservation Foundation. *Rookery Bay Area Project: A Demonstration Study in Conservation and Development, Naples, Florida.* Conservation Foundation (1250 Connecticut Ave. NW, Washington, DC 20036), 1968. Paperbook, 61 pp. $2.50.

The purpose of this project was to determine if profit-oriented development surrounding the Rookery Bay Sanctuary can be compatible with conservation principles. The study concluded that it can (and, in fact, that environmentally oriented development is in the economic self-interest of the developers) provided that careful planning is done, a single "development mechanism" is created to coordinate planning and development of all or most of the private lands in accordance with a development plan for the area, and this organization is given a commitment for a 10 to 20 year period.

Dasmann, Raymond F. et al. *Ecological Principles for Economic Development.* Toronto: Wiley, 1973. Paperback, 252 pp. $5.25.

This book introduces "development", its goals and their attainment; presents ecological considerations applicable to all development; discusses development of humid tropical lands and pastoral lands in semi-arid and sub-humid regions; and goes further into ecosystem considerations in tourism, agricultural and river basin development projects.

Donnan, J. and Victor, P. *Alternative Policies for Pollution Abatement: The Ontario Pulp and Paper Industry.* Ontario Ministry of the Environment (135 St. Clair Ave. W., Toronto M4V 1P5), 1976.

Doyle, William S. *Strip Mining of Coal: Environmental Solutions.* Noyes Data Corp. (Mill Road at Grand Ave., Park Ridge, NJ 07656), 1976. Hardcover, 352 pp. $32.00.

Summarizes 19 government reports on different aspects of strip mining, examines

solutions to the many severe environmental problems it can create (sediment, erosion, revegetation, acid drainage, water quality, etc.), and thoroughly analyses costs of reclamation including two (American) case studies in flat and hilly areas. See also: D. Darcey et al., Strip Mine Blasting: *A Study of Vibrational Pollution* (Washington, DC: Center for Science in the Public Interest, 1977), 124 pp., $25.00.

Enthoven, Alain C. and Freeman, A. Myrick III (eds.). *Pollution, Resources and the Environment.* New York: W.W. Norton, 1973. Paperback, 285 pp. $2.95.

Collection of 26 papers including Garrett Hardin's well-known "The Tragedy of the Commons" and Kenneth E. Boulding's "The Economics of the Coming Spaceship Earth". Other papers discuss such topics as the use of effluent charges to control pollution and the environmental effects of economic growth.

Fahselt, Dianne, "Rare geological record endangered by pit plan", *Globe and Mail*, 29 June, 1978, p. 7.

Documents a case in which a proposed quarrying operation threatened to destroy a unique outcrop of sandstone, said to hold the only key to life in Canada 380 million years ago, and the Niagara Escarpment (see 5.4 Plans) near Cayuga in southwestern Ontario's Haldimand-Norfolk region.

Gray, Malcolm, "Smelter hazards at Alcan linked to worker's ills", *Globe and Mail*, 22 November, 1977.

A year-long health study was reported to have linked diseases and abnormalities of the lungs and skeletal systems of workers to hazardous substances used in the giant aluminum smelter at Kitimat, B.C. The cross-sectional study of the plant's workforce in November 1976 found that almost 30% of 1 242 smelter workers had an abnormally reduced lung capacity and 500 to 600 workers were suffering from skeletal disorders which had resulted in lower back surgery for 85 employees of the Aluminum Company of Canada. Commissioned by the Canadian Association of Smelter and Allied Workers, the $187 000 study was conducted by two U.S. experts, Dr. Bertram Carnow and Dr. Shirley Conibear.

Gorham, C.F., "The Role of Environmental Assessment in a Major Pulpmill Expansion Program", in *Proceedings of the 24th Ontario Industrial Waste Conference*, May 30 – June 1, 1977, Toronto, Ontario. Ontario Ministry of the Environment (135 St. Clair Ave. W., Toronto M4V 1P5), 1977.

Krebs, Giraid, "Technological and Social Impact Assessment of Resource Extraction: The Case of Coal", *Environment and Behaviour*, Vol. 7, No. 3, Sept. 1975, pp. 307-329.

Krueger, Ralph R. and Mitchell, Bruce (eds.). *Managing Canada's Renewable Resources.* Toronto: Methuen, 1977. Paperback, 333 pp. $9.95.

Overviews Canadian resource management, then presents 22 papers on natural resource perspectives, assessment and decision-making, land and water. See especially, P.H. Pearse, "Natural Resource Policies: An Economist's Critique".

McEvoy, James III and Dietz, Thomas (eds.). *Handbook for Environmental Planning: The Social Consequences of Environmental Change.* New York: Wiley, 1977. Hardcover, 323 pp. $25.75.

Chapter 7 (pp. 241-278), by R.J. Burdge and S. Johnson, presents "Sociocultural Aspects of the Effects of Resource Development" using the comparative diachronic model (a study of the same phenomenon at two different points in time). Includes a detailed step-by-step account of application of the community impact approach.

Milne, A.R. and Smiley, G.C. *Offshore Drilling for Oil in the Beaufort Sea: A Preliminary Environmental Assessment.* Victoria, B.C.: Department of the Environment, January 1976. Paperback, 43 pp. Available from Inrormation Branch, Fisheries and Marine Service, Environment Canada (Ottawa K1A OH3).

Muirhead, Clark, "The War Against Gravel Pits", *Globe and Mail*, 23 June, 1978.

Newport, B.D. and Moyer, J.E. *State of the Art: Sand and Gravel Industry.* National Environmental Research Center, Office of Research and Development, U.S. Environmental Protection Agency (Corvallis, Oregon 97330), 1974. 40 pp.

Storm runoff and plant process water were found to be the two main sources of water pollution associated with sand and gravel production, the largest non-fuel mining operation in the United States. Surface mining for this purpose has disturbed over a million acres (nearly 4.5 million acres have been disturbed by all surface mining activities). This report provides an overview of the industry and its relationship to the environment, discusses sediment-related effects in detail, and examines problems of the industry and its regulation.

North Island Study Group. *Tsitika-Schoen Resources Study.* B.C. Ministry of the Environment (Parliament Buildings, Victoria V8V 1X4), 1975.

Ontario Ministry of Natural Resources. *Vegetation for the Rehabilitation of Pits and Quarries.* Ministry of Natural Resources, Forest Management Branch, Division of Forests (99 Wellesley St. W., Toronto M7A 1W3), 1975. Paperback, 38 pp.

O'Riordan T. *Perspectives on Resource Management.* Pion Ltd. (207 Brondesbury Park, London NW2 5JN, England), 1971. Hardcover, 183 pp. $l0.00.

Useful basic source that describes resources and management in Canada from a historical perspective, then discusses feasibility and evaluation in resource management, social costs and benefits, efficiency in resource use, environmental management, attitudes of resource managers, decision making in resource management, and future perspectives. Annotated further in 5.1 Environmental Planning in a Management Framework.

Ortolano, Leonard and Hill, William W. *An Analysis of Environmental Statements for Corps of Engineers Water Projects.* Washington, DC: U.S. Army Corps of Engineers, 1972. 135 pp. Available from National Technical Information Service (5285 Port Royal Road, Springfield, VA 22161), AD-747 374.

This publication presents the results of an intensive analysis of 234 environmental impact statements for water resource projects (breakwaters, dikes and barriers, dams and reservoirs, channelization, dredging, etc.). Their environmental impacts are catalogued and summarized.

Proctor and Redfern Ltd. and Gartner Lee Assoc. *Mineral Aggregate Study and Geological Inventory, Southwestern Region of Ontario.* Toronto: Ministry of Natural Resources, 1977. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $25.00, cheque payable to Treasurer of Ontario. Summary volume $1.00.

Covers mineral resources, supply-demand present and future, distance, transportation and policy recommendations. Similar reports are available for Eastern Ontario ($30.00) and Central Ontario ($25.00). See also: Proctor and Redfern Ltd., *Towards the Year 2000: A Study of Mineral Aggregates in Central Ontario* (Ontario Ministry of Natural Resources, 99 Wellseley St. W., Toronto M7A 1W3), 1974.

Québec, Services de protection de l'environnement. *Étude de la Rivière Chamouchouane: Effets prévisibles des déversements de l'Usine Donohue St-Félicien Inc. sur la ressource eau et Ouananiche.* Services de protection de l'environnement (914 rue Paradis, Ste-Foy, Qué. G1V 2T6), juin 1977.
358 pp.

An environmental impact assessment of a Kraft pulp mill at St-Félicien.

Ridker, Ronald G. (ed.). *Population, Resources, and the Environment.* Washington, DC: The Commission on Population Growth and the American Future, 1972. Paperback, 377 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $4.25 + 25% outside U.S.A.

A collection of papers dealing with the resource and environmental consequences of population growth in the United States. See also: Joint Economic Committee, Congress of the United States, *Resources Scarcity, Economic Growth and the Environment*, 1974, U.S.G.P.O., $1.60 + 25% outside U.S.A.

Russell, Clifford S. *Residuals Management in Industry: A Case Study of Petroleum Refining.* Baltimore: Johns Hopkins University Press, 1973. Hardcover, 193 pp. $12.00.

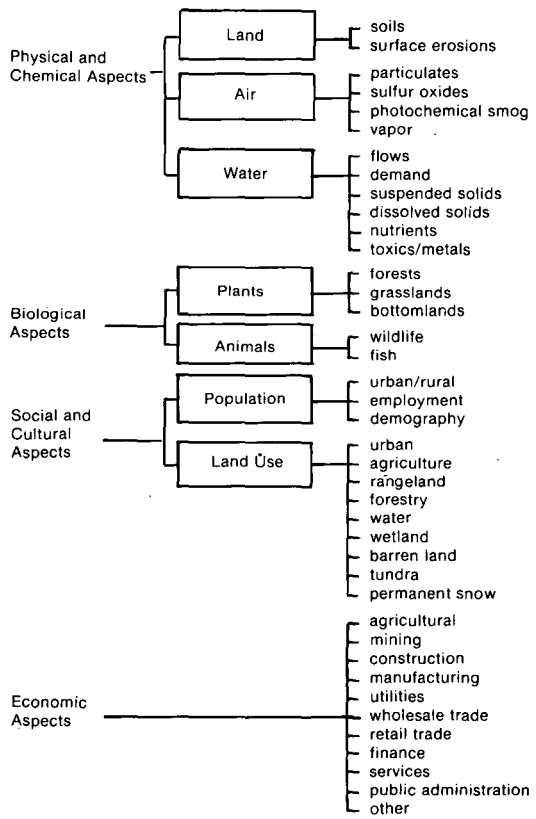
Schier, H. *Water Quality Considerations in the Northeast B.C. Coal Area.* Environment Canada, Inland Waters Directorate, Water Quality Branch (1001 West Pender St., Vancouver V6E 2M7), 1977. 57 pp.

Much of this report is devoted to a review of literature on the impacts of coal mining on water quality. A concise summary that should be a useful guide to coal developers and monitoring agencies designing water quality enhancement programs for areas near mine sites.

Schlesinger, Benjamin and Daetz, Douglas. *Development of a Procedure for Forecasting Long-Range Environmental Impacts.* Stanford, CA: Stanford University, 1975. 137 pp. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), PB-224 974, $8.00.

This report, prepared for the Resource and Land Investigations Program of the U.S. Geological Survey, presents a procedure for forecasting long-range environmental impacts on large-scale projects. The method, which attempts to generate a consistent systematic basis for comparing development alternatives, combines (a) a schedule of primary environmental impact expected as a result of future activities, with (b) a matrix of environmental factor relationships. Each term (physical/chemical, biological, socio-cultural and economic aspects) in this cross-impact matrix uses a linear multiplier to relate a change in one factor in one year to a change in another factor in the following year. A proposed extended version of the matrix would contain additional terms to reflect the impact of several environmental factors changing at the same time; thus, approximate forecasts for each of a set of environmental factors could be produced that considered both direct and higher order impacts. The method is applied to a case study of a coal field development in Wyoming.

Simplified Hierarchy of Environmental Aspects (Schlesinger and Daetz)



Science Council of Canada. *Population, Technology and Resources.* Supply and Services Canada (Printing and Publishing, Ottawa K1A OS9), 1976. 91 pp. $2.50 ($3.00 outside Canada).

Sewell, W.R.D., "Broadening the Approach to Evaluation in Resource Management Decision-Making", *Journal of Environmental Management,* Vol. 1, 1973, pp. 33-60.

Sewell, W.R.D. and Burton, Ian (eds.). *Perceptions and Attitudes in Resource Management.* Ottawa: Policy Research and Coordination Branch, Dept. of Energy, Mines and Resources, 1971. Paperback, 147 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A OS9), $3.00.

Section I deals with concepts, theories and techniques involved in studies of attitudes and perceptions and the social role of such studies. Section II contains case studies of selected resource problems including beach pollution and air pollution in Toronto and water supply in London, Ontario and the Grand River Basin. Section III deals with public involvement in the planning process.

Sidho, S.S. and Case, A.B. *A Bibliography on the Environmental Impact of Forest Resource Roads: A List.* Environment Canada, Newfoundland Forest Research Centre (Building 304, P.O. Box 6028, Pleasantville, Nfld. A1C 5X8), Information Report N-X-149, 1977. 28 pp. Free.

Smith, M.F. *Environmental and Ecological Effects of Dredging (A Bibliography with Abstracts).* December 1976. 214 pp. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), PS-76/0948/OP56, $25.00.

Statistics Canada. *Human Activity and the Environment.* Statistics Canada, Office of the Senior Advisor on Integration (Ottawa K1A OT6), 1978. Paperback, 183 pp. $2.80 ($3.40 outside Canada).

Annotated in 2.7 Natural Environments and Human Activities.

Tank, Ronald W. (ed.). *Focus on Environmental Geology.* Second Edition. New York: Oxford University Press, 1976. Paperback, 538 pp. $5.75.

A collection of readings and case histories. Included are sections on erosion and sedimentation, mineral resources and the environment (with five papers on environmental impacts), water resources and waste disposal.

U.S. Department of Agriculture. *Planning Natural Resource Development: An Introductory Guide.* U.S. Department of Agriculture, Economic Research Service (Washington, DC 20250), 1972.

U.S. Forest Service. *General Plan for Management of National Forest Lands in the Lake Tahoe Basin.* U.S. Department of Agriculture, Forest Service (P.O. Box 245, Berkeley, CA 94701), 1973.

Detailed analysis of the problems of an environmentally sensitive area and a management plan designed to accommodate heavy usage for recreation purposes while preserving environmental quality.

Warner, Maurice L. et al. *An Assessment Methodology for the Environmental Impact of Water Resource Projects.* Washington, DC: U.S. Environmental Protection Agency, Office of Reseach and Development, 1974. 221 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402). $3.00 + 25% outside U.S.A.

This report presents materials, intended for use by reviewers of environmental impact statements on major water reservoir projects, under six headings: reservoir project planning, construction and operation; water quality aspects of reservoir construction; ecological impacts of reservoir construction; economic, social and aesthetic impacts of reservoir construction; review criteria for assessing general statement completeness and accuracy; and a 34 page review of environmental impact assessment methods.

Watt, Kenneth E.F. *Ecology and Resource Management: A Quantitative Approach.* New York: McGraw-Hill, 1968. Hardcover, 450 pp. $15.25.

A basic text covering theory, principles and methods of resource management from an ecological perspective. See also: Watt, *Principles of Environmental Science,* annotated in 1.2 Characteristics of Environmental Problems.

White, Gilbert F. *Strategies of American Water Management.* Don Mills, Ont.: Longmans of Canada, 1971. Paperback, 155 pp. $2.85.

Whitman, Iva L. et al. *Design of an Environmental Evaluation System.* Washington, DC: U.S. Dept. of the Interior, Bureau of Reclamation, 1971. 61 pp. + app. Available from National Technical Information Service 5285 Port Royal Rd., Springfield, VA 22161), PB-201 743, $6.00.

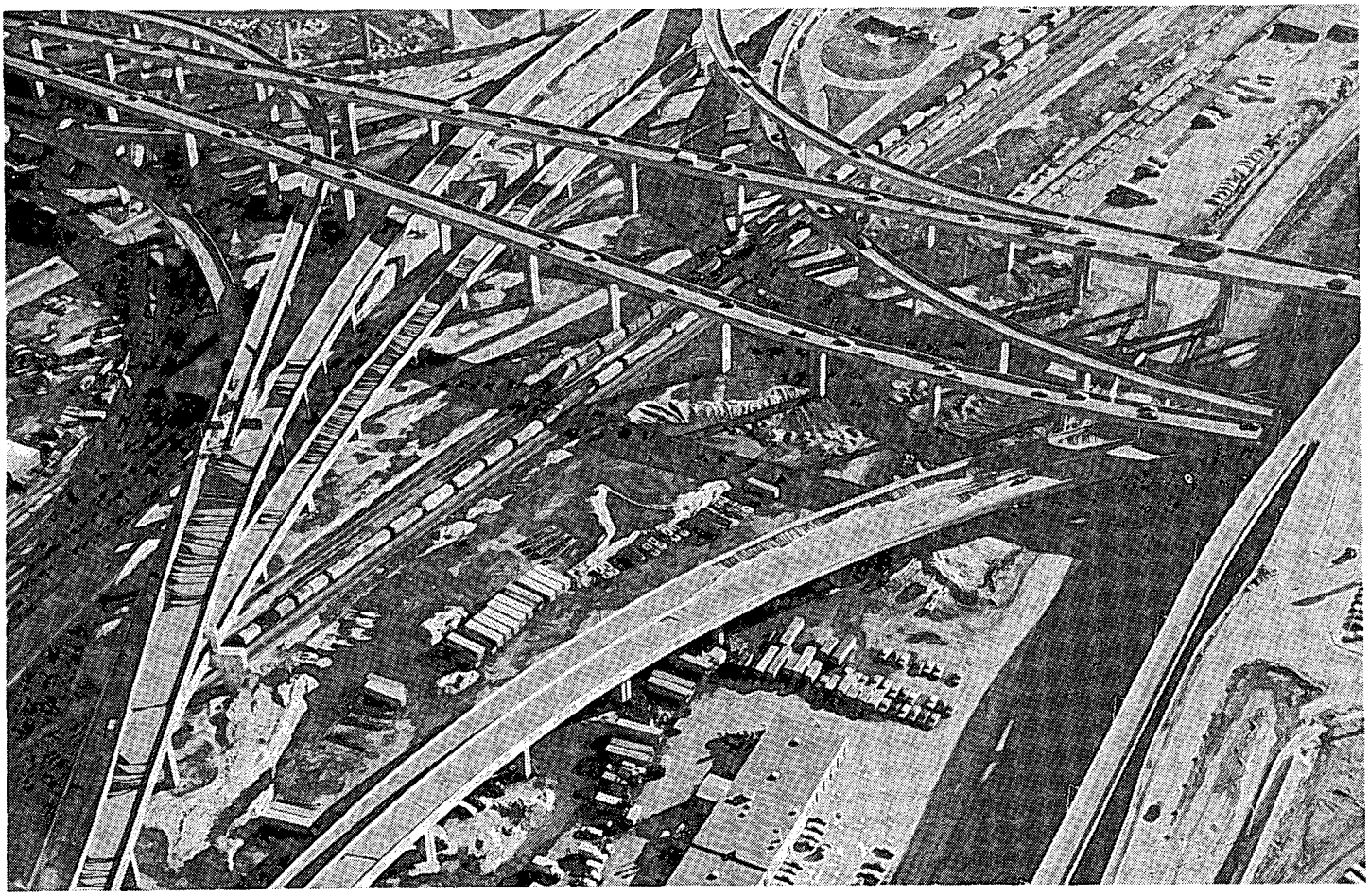
This report, by Battelle Memorial Institute, presents an environmental evalution system for use by the Bureau in determining environmental impacts of water resource projects. The EES is based on a hierarchical arrangement of critical environmental quality parameters arranged in four major categories divided into 17 components: ecology (species and populations, habitats and communities, ecosystems); environmental pollution (water, air, land and noise pollution); aesthetics (land, air, water, biota, man-made objects, composition); and human interest (educational-scientific, historical, cultural and mood-atmosphere significance). Relative values of the environmental effects

associated with each component and category were designed to provide a weighting system of environmental impacts totalling 1 000 "environmental quality units". Field testing is required to prepare the system for application. See also: Norbert Dee et al., *Fiscal Report on Environmental Evaluation System for Water Resources Planning*, 1972 (annotated in 5.5 Environmental Impact Assessment).

4.5 Transportation

Where vast distances separate parts of a country, the movement of people and goods can be expected to assume major importance in national life. It has been so from Canada's beginnings, when the building of a transcontinental railway was a prominent feature of Sir John A. Macdonald's national policy and ocean shipping linked the young country with the world, to the present day with its supertankers, jumbo jets, transport trucks, unit trains, rapid transit, snowmobiles and pipelines. Transportation, excluding automobiles, accounts for nearly 6% of Canada's gross domestic product. Large investments in facilities and equipment provide built-in incentives for their use. Mobility, convenience and dependence on transportation lock it securely into the lifestyle most Canadians know and expect.

Environmental stress and energy uncertainties increasingly intrude into this picture, often subtly. While some environmental and energy impacts are readily apparent – consider oil spills and increased costs at the gas pump – most are not simple cause-effect relationships. Urbanization, for example, is both a cause and an effect of high-capacity transportation networks. Population growth, economic activity and transport technology affect the service provided by these networks. Furthermore, changes in technology



and peoples' preferences alter the popularity of different modes of transport, thereby changing the nature and distribution of transportation impacts. Sometimes these are diffused, as with air pollution. At other times they are focused in a single location – the intermodal truck-rail piggyback terminal recently introduced in Brampton, Ontario is an example – which then increases the likelihood of public protest.

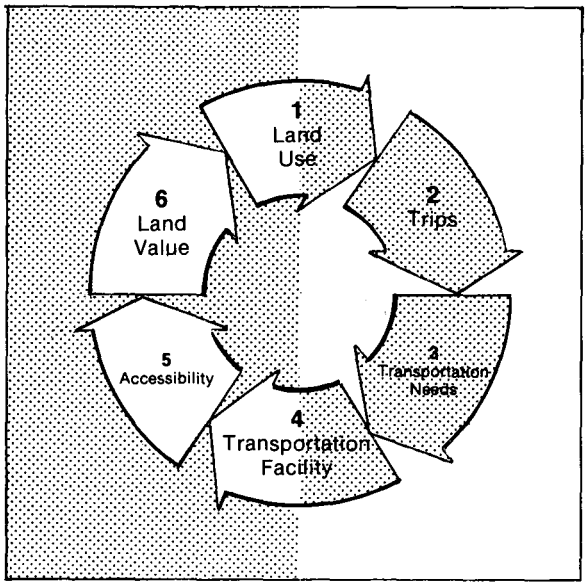


Figure 4.7 Land Use/Transportation Interaction

The way land is used**1** generates trips**2**. The need to make trips creates transportation needs**3** which are met by construction of a transportation facility**4**. This provides accessibility**5** permitting people to get to the site which in turn raises land values**6** and affects the use of land**1**.

Highways, the largest transport mode, can produce a variety of adverse environmental/social effects:

Air pollution from engine emissions. According to Winthrop, 57% of all air pollution in 1970 resulted from transportation, by far the largest single source (second on the list was industrial processes, 25%).

Altered storm runoff. Hard-surfaced roads, graded streets and parking lots increase the amount and rate of runoff to receiving watercourses, create erosion (according to Scheidt, divided lane highways, which require 10 to 35 acres of land per mile, produce about 3 000 tons of sediment per mile) and contribute to water pollution. Highway surfaces accumulate rubber particles, asbestos from brake linings, oil and grease, gasoline, deicing salt or calcium chloride, heavy metals from air pollution, and compounds from the pavement. Eventually these are likely to end up in watercourses (see 2.3 Urban Runoff).

Damage to roadside vegetation. Use of deicing salt can damage roadside vegetation and produce other environmental impacts including contamination of surface and ground water. Spraying road rights-of-way with herbicides for weed control can be similarly harmful. Careless construction can expose roots, lower water tables and eventually destroy roadside trees.

Noise. Although noise can be extremely annoying, and even physically and mentally harmful to some people, housing continues to be built next to heavily travelled roads. Many people appear willing to trade off noise levels for improved accessibility. Many others, however, have little choice.

Altered lifestyle. A new highway providing access to a previously remote area or settlement can substantially change, not always for the better, the lifestyle of the people and communities affected.

Railways, a mode of transport in relative decline in recent years, are making a comeback on some fronts (such as freight) and remain an important component of the transportation system. Their potential adverse environmental effects include:

Noise. Sources include engines, wheels, whistles and marshalling yard activities, the last two producing the most complaints.

Vibration. Shortly after completion of the new Spadina subway line in Toronto, for example, nearby residents began complaining about vibration being felt in their houses. Structural damage may accompany severe vibration.

Air pollution. Locomotives that burn diesel fuel emit the largest amount of pollutants in low gear on grades and during idling. Electrification of rail lines, often advocated to improve efficiency, would merely transfer the air pollution to a point source but would make it possible to change fuels.

Barriers and hazards. Railway tracks, along with major arterial roads, can impede traffic, block development, isolate neighbourhoods

Acknowledgements 4.5

This section includes contributions from:

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Andre Cardinal
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Wilson Eedy
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Michel Lagace
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Paul Mackey
Bo Martin
Nancy McInnis
Ian Wight
Phil Wood

physically and psychologically, fragment farm and forest land, prevent access to environmental amenities such as waterfronts, block wildlife corridors and alienate wildlife habitats. Rail facilities remain a substantial hazard to human and nonhuman life.

Visual. Rail and other transportation facilities may be aesthetically disruptive. Their improper location has potential for destroying the character of valued landscape.

Air transportation is another mode that can produce undesired environmental effects, including:

Noise. Statistics Canada estimates that in five metropolitan areas of Canada alone – Montreal, Toronto, Vancouver, Ottawa and Edmonton – 665 990 people, 10% of the total population of these areas (it is 16% in Montreal) were affected by aircraft noise in 1971. Nearly 100 000 of these people were in "upper noise zones" experiencing severe noise levels. Residential encroachment on airports, as on rail and road facilities, continues to be a common occurrence especially in rapidly urbanizing areas where high land values and tight housing markets cause producers and consumers to disregard noise (at least initially).

Land consumption. Recent airports built or proposed (e.g. Mirabel, Pickering) consume or would consume large acreages of land, usually valuable and often prime agricultural land.

Air pollution from engine exhausts. Indirectly, airports also cause considerable added air pollution by generating large volumes of automobile traffic.

Bird kills and interference with bird migration. High rates of bird collision mortality are also associated with highways and railways in certain rural resource areas.

Marine facilities can also have adverse environmental consequences:

Spillage, especially of oil. The recent wreck of the Amoco Cadiz off the French coast underlines this problem. Vast quantities of oil, not to mention garbage, are also dumped from ships as bilge. Spillage frequently occurs at offshore buoys designed to transfer oil from ship to shore. Offshore drilling rigs can be extremely difficult to cap if they go out of control. Oil can ruin water and shoreline for recreational uses, increase water treatment costs, interfere with planktonic photosynthesis, and destroy valued amenities.

Dredging, which can increase water turbidity, destroy or upset benthic life and alter habitats.

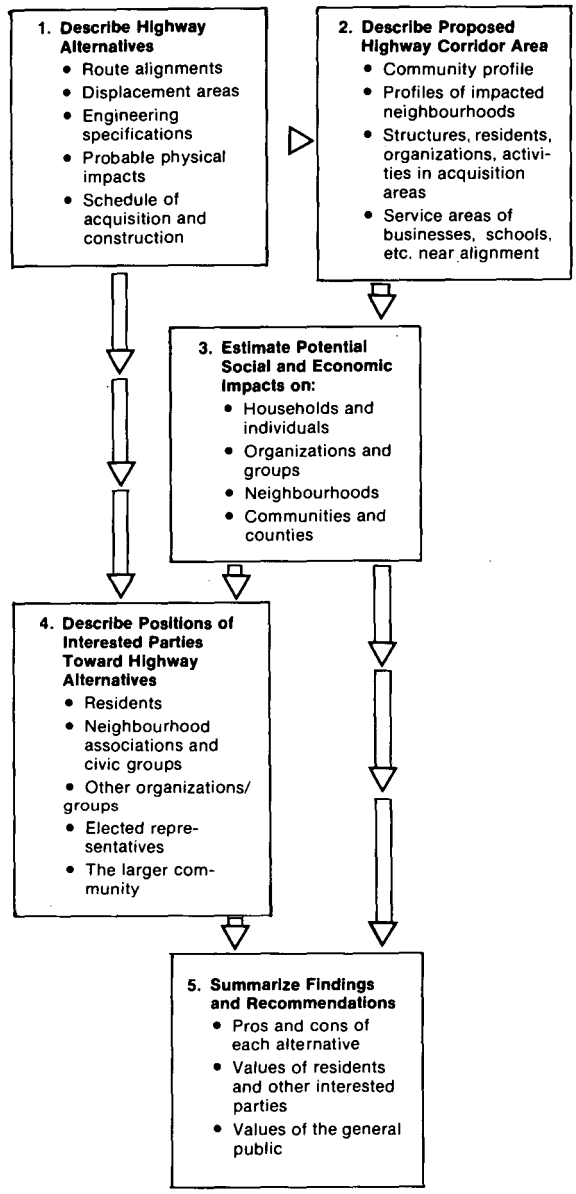


Figure 4.8 Social Impact Assessment of a Proposed Highway Location

Source: adapted from Kurt Finsterbusch, *A Methodology for Social Impact Assessments of Highway Locations* (Baltimore, MD: Federal Highway Administration, 1976)

Identifying potentially adverse environmental effects of transportation is only the tip of the iceberg. Quantifying and evaluating these effects and incorporating them into planning and management are the more difficult but necessary next steps. Interrelationships among modes of transport and between various land uses they serve, together with accompanying economic and social effects, often make it quite difficult to isolate the environmental impacts of a transportation facility. Furthermore, the secondary effects – the urban development activity that would have accompanied the creation of 40 000 new jobs at the proposed Pickering Airport northeast of Metro Toronto, for example, or the indirect impacts of increased access and use of a wilderness area resulting from a new highway – can be much more significant and much harder to assess than the transportation facility itself. Finally, planning to prevent or alleviate undesired environmental side-effects of transportation often conflicts with prevailing social values. Over half of the journey-to-work trips in Canada are made by automobiles without passengers; even recent sharp increases in fuel costs have scarcely altered that behaviour pattern. Adverse environmental effects and energy costs would be reduced if more people used public transit but this would mean longer and more time-consuming trips, less convenience and reduced comfort – all apparently highly valued, along with the automobile itself. Behavioural changes seem more likely to spring from a sense of grim necessity than from enthusiasm for environmental quality.

Case Study 65
Pollution Drives Denver to Buses

Denver has just beaten Los Angeles to the unenviable position of being the most polluted city in the United States. A year's monitoring of air standards by Colorado's department of health ended recently without a single "good" day being recorded; on more than one day in three the air violated federal safety standards.

For a city that has boomed on the boast of being a fine place to live, nestled at the foot of the unspoiled Rockies, close to ski resorts and the open spaces of the West, the vile pall of smog that hangs over Denver is becoming a real threat to its economy. Denver is now the fourth most rapidly growing city in the country and the undoubted centre of the Rocky Mountain West; its pollution is the product both of its growth and of the very climate that has attracted people to it. During the winter the cold air spills off the Rockies, clamping an atmospheric lid over the Denver basin and trapping carbon monoxide in a concentrated bubble some 300 feet over the city; in the summer the bright sunlight activates the gases from car exhausts to produce an intolerable level of ozone that stings the eyes and damage the lungs.

Some 90% of the air pollution is caused by the more than one million cars in this city of 1.5 million people. Thus the city has had to mount a campaign against the privately owned car. This is a particular irony in a city that now rivals Houston as a centre for the oil industry; more than 1 000 oil companies rent about half of all the available office space in downtown Denver.

Source: Extracted from *The Globe and Mail*, 22 June 1978, p. 7 (taken from *The Economist*). The remainder of the article describes Denver's "imaginative and aggressive system of transport" which is attempting to get people out of automobiles into buses.

Case Study 66
The High Cost of Road Salt

In a recent report, the Great Lakes Research Advisory Board cites the use of road salt to show (a) how a seemingly trivial matter from a water quality point of view is actually a severe economic and environmental problem in an ecosystem context and (b) that an alternate concept of "man in nature" can bring returns to the pocketbook.

Approximately 2.8 million metric tons of road salt, 80 kg (175 lb.) per person, are used each year in the Great Lakes Basin. The concentration of chloride in the lakes, 30-60% of it from road deicing, has more than tripled in this century, from 7.5 to 28 mg per litre. The demand that roads be safe and usable at all times, with June driving conditions in January, has led to a "bare pavement" policy by most highway Departments and an accompanying huge increase in the use of deicing salts and abrasives. This has happened even though no conclusive evidence exists to substantiate the claim that salt usage makes winter travel safe. One report concluded that the use of salt for winter maintenance generally results in better traction on the highways but because of a number of confounding factors, especially driver behaviour, the link between salt and safety has not been proved. Yet, for the U.S. snow belt states, road salt in

1973 cost an estimated $2.91 billion. This excludes the "hidden costs" (damage to vehicles, highways, structures, utilities, vegetation, and some of the costs to water supplies and human health) which were at least 15 times the annual national budget for purchasing and applying road salt, and 6 times the entire national budget for snow and ice removal. In a cited case study, doubling the community's total snow removal budget from $123 000 to $245 000 used less salt and resulted in a reduction of the total cost to the community from $829 500 to $499 700, a net saving of a third of a million dollars per year.

The Board wonders how we survived 20 years ago when road salt use was a fraction of what it is now, and how many northern communities manage to get through the winter without road salt. Is June driving behaviour in January necessary at such cost, in view of the fact that people tend to drive at constant risk? Is it more important than, say, increasing the expenditure on sewage treatment, environmental health measures or other priorities? Unfortunately, the Board concludes, such questions are likely to draw little response until (a) "environment" is defined to bring man into the system and government agency mandates are re-ordered so as to legitimize the confronting of the "hidden" costs, and (b) the conflict between public demands for highway convenience/safety and public concern over environmental effects is exposed and confronted.

As Castrilli and Dines point out, these contrasting public views have contributed to a lack of legislative action. Road salting operations in the public sector at present are minimally and haphazardly controlled.

Refer to:
Great Lakes Research Advisory Board, *The Ecosystem Approach: Scope and Implication of an Ecosystem Approach to Transboundary Problems in the Great Lakes Basin*, International Joint Commission. 1978, free. Annotated in 2.3 Water Quality.

J.F. Castrilli and A.J. Dines, *Control of Water Pollution from Land Use Activities in the Great Lakes Basin: An Evaluation of Legislative and Administrative Programs in Canada and the United States*, International Joint Commission, 1978. Free. Annotated in 2.3 Water Quality.

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Case Study 67
North Pickering Arterial Roadway Planning
Submitted by Wilson Eedy, Beak Consultants Ltd.

North Pickering is a new community, with a planned population of 75-90 000, being developed by the Ontario government on a 7 000-acre site northeast of Metro Toronto. Arterial roadway planning included environmental studies to help determine road locations, residential zones, industrial and commercial districts and nature conservation areas.

In the refinement of the grades and alignments for arterial roads, existing studies were reviewed to determine the location of, and where possible avoid or reduce the impact on, quality environments. Grades were proposed that would minimize environmental problems related to runoff, concentration of air pollutants and traffic safety.

District planning has not yet commenced and therefore the extent to which environmental inputs affected planning decisions is not known.

Refer to:
Beak Consultants, *Review of Natural Environmental Implications of North Pickering Stage I Arterial Roadways*, July, 1977.

North Pickering Development Corporation, *Environmental Management Opportunities and Constraints within the North Pickering Site* Ontario Ministry of Housing, North Pickering Project (950 Yonge St., Toronto M7A 2K4), 1975. Annotated in 5.4 Plans.

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Case Study 68
Transportation Links in the Northwest Coal Block of B.C.
Submitted by Ray Crook, Environment and Land Use Committee Secretariat

A major objective of the provincial government's Northeast Coal Study (see 4.4 Resource Development) has been to evaluate the potential environmental impacts of proposed road

and rail routes to new coal mines. A lengthy summary of the associated resource considerations is found in: Environment and Land Use Sub-Committee on Northeast Coal Development, *Northeast Coal Study – Preliminary Environmental Report on Proposed Transportation Links and Townsites.* B.C. Ministry of the Environment (Parliament Buildings, Victoria V8J 1X4), May 1977, 141 pp.

Additional evaluations of potential route impacts may be found in:

B.C. Ministry of the Environment, Resource Analysis Branch. *Outdoor Recreation Resources of the Northeast Coal Study Area 1976-1977.* The Ministry, July 1977. 71 pp.

B.C. Ministry of the Environment, Resource Analysis Branch, and Ministry of Recreation and Conservation, Fish and Wildlife Branch. *Wildlife Resources of the Northeast Coal Study Area 1976-1977.* Ministry of the Environment, Nov. 1977. 58 pp.

B.C. Ministry of Recreation and Conservation, Fish and Wildlife Branch. *Wildlife-Related Motor Vehicle Accidents in B.C.: A Preliminary Assessment of the Problems Based on a Review of Motor Vehicle Accident Reports Forms.* The Branch (Parliament Buildings, Victoria V8J 1X4), April 1978. 5 pp.

McDonald, Barbara. *Transportation Corridor/ Wild Ungulate Conflicts and Possible Solutions: An Annotated Bibliography.* B.C. Ministry of Recreation and Conservation, Fish and Wildlife Branch (Parliament Buildings, Victoria V8J 1X4), August 1977. 48 pp.

Tetlow, R.J. and Sheppard, S.R.J. *Visual Resources of the Northeast Coal Study Area 1976-1977.* Ministry of the Environment, Sept. 1977. 104 pp.

Trenholme, N. *Aquatic Migratory Bird Resources of the Northeast Coal Study Area.* Canadian Wildlife Service (Delta, B.C.), August 1978. 45 pp.

Information Resources

Alberta Transportation. *Grande Prairie – Grande Cache Area Environmental Planning Study.* Alberta Transportation (9630 – 106th St., Edmonton T5K 2B8), in progress.

A comprehensive study intended to provide the broad context for a decision on a new highway location through a semi-wilderness, resource-rich area on Alberta's Eastern Slopes. The study emphasizes inter-agency coordination and public participation. Contact M. Vaselanek, Senior Environmental Planner, Strategic Planning Branch, Alberta Transportation.

Armour, Audrey, Lang, Reg and Hughes, William. *Impacts of Urban Railways.* University of Toronto/York University, Joint Progam in Transportation (150 St. George St., Toronto M5S 1A1), 1978.

The report documents what is known about the impacts of railway operation in urban areas; examines the extent to which the environmental and developmental effects of railways present a problem for Canadian cities and towns now and in the future; explores community response to railway impacts and the issue of residential encroachment on railway rights-of-way; and assesses the state-of-the-art of predicting and evaluating the potential impacts of changes to railway operation and facilities including relocation, consolidation, abandonment, expansion, intermodal transportation improvements (such as grade separations, integrated terminals or piggy-back yard facilities) and new commuter rapid rail transit.

Ayres, Robert U. and McVenna, Richard P. *Alternatives to the Internal Combustion Engine: Impacts on Environmental Quality.* Baltimore: Johns Hopkins University Press, 1972. Hardcover, 322 pp. $12.00.

Barbaro, Ronald and Cross, Frank L., Jr. *Primer on Environmental Impact Statements.* Technomic Publishing (265 W. State St., Westport, Conn. 06880), 1973. Paperback, 140 pp. $22.00.

An early "handbook" on environmental impact assessment. One of the applications described (Chapter 8, pp. 102-131) is impacts from marine facilities, especially dredging (see also U.S. Environmental Protection Agency).

Bascom, S.E. et al. *Secondary Impacts of Transportation and Wastewater Investments: Review and Bibliography.* January 1975. 276 pp. *Secondary Impacts of Transportation and Wastewater Investments: Research Results.* U.S. Dept. of the Interior, Water Resources Scientific Information Center (Washington, DC 20240) and U.S. Environmental Protection Agency, Office of Research and Development (Washington, DC 20460), July 1975. 209 pp.

These two volumes present results of original research on the extent to which secondary developmental impacts can be attributed to highways and sewage collection and treatment systems (see also: Urban Systems Research and Engineering, Inc., *The Growth Shapers: The Land Use Impacts of Infrastructure Investments*, U.S. Council on Environmental Quality, 1976; annotated in 4.2 Urbanization). Case studies of Boston, Washington and Minneapolis-St. Paul are presented.

Bennett, E. et al. *Air Quality Considerations in Transportation Planning.* Cambridge, MA: M.I.T., December 1975. Available from National Technical Information Centre (5285 Port Royal Rd., Springfield, Va 22161), PB-256 424.

Berger, Mr. Justice Thomas R. *Northern Frontier, Northern Homeland. The Report of the Mackenzie Valley Pipeline Inquiry: Volumes One and Two.* Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), 1977. Vol. 1 and 2, $5.00 each ($6.00 outside Canada).

Annotated in 5.5 Environmental Impact Assessment.

Canadian Broadcasting Corporation, "Tankerbomb". CBC (1500 Bronson Ave., P.O. Box 8478, Ottawa K1G 3J5), 1978. Also, Blaik Kirby, "CBC's Tankerbomb indictment of oil shipping", *Globe and Mail*, 20 May, 1978, p. 36.

A one-hour CBC-TV documentary film, narrated by David Suzuki and first shown in May 1978, that examines environmental and other issues surrounding the ocean transport of oil off Canada's shores especially on the west coast. According to the *Globe and Mail*, the film concludes: an oil shipping disaster off Canada's coast is inevitable; Ottawa is doing nothing to prevent it and lacks even the tools to mop it up; our maritime laws are weak or unenforced; and our environmental laws are so feeble that we are about to allow a dangerous gas plant (on the Bay of Fundy, to convert liquid natural gas, imported from Algeria and exported to the U.S.) which the United States has barred.

Canadian Transport Commission. *Transport Review: Trends and Selected Issues.* Canadian Transport Commission, Economic and Social Research Directorate (275 Slater St., Ottawa K1A ON9), February, 1977. Paperback, 97 pp.

Part I of this report is a presentation and review of statistical data on the transport sector in Canada. Part II discusses selected issues including: the decline in rail patronage and the increase in passenger subsidies; the profit squeeze on air passenger carriers; rail freight rates; the need to increase investment with an unimpressive earnings record; and the effect of inflation on transport industries.

Coleman, D.J. *Highways and the Environment: A Bibliography of the Effects of Highways on the Physical, Biological, Recreational and Aesthetic Environments and of Techniques for the Analysis of these Impacts.* Council of Planning Librarians (Box 229, Monticello, IL 61856), 1973. $2.00.

Creighton, Roger L. *Urban Transportation Planning.* University of Illinois Press, 1970. Hardcover, $10.00.

A basic text. Chapter VI usefully summarizes the urban transportation planning process.

Earp, J.H. et al. (eds.). *Transportation and Environment: Policies, Plans and Practice.* Southampton University Press, 1973.

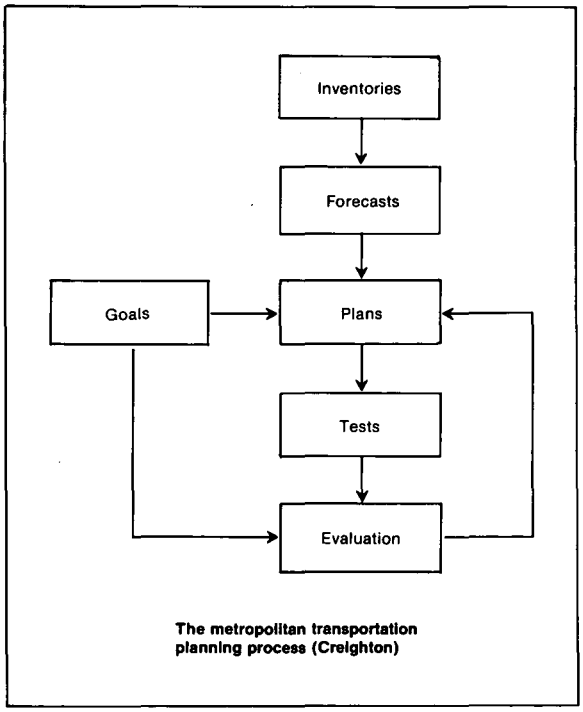
A collection of 39 papers accompanied by a report on the ensuing discussions at a symposium held at the University of Southampton in April 1973.

Environment Canada. *An Appraisal of the Environmental Consequences of the Development Proposed for Lorneville, N.B.* Environment Canada (Ottawa K1A 0H3), 1973. Vol. 1: $4.00. Vol. 2: $12.50. Résumé volume free.

Environment Canada, Lands Directorate. *An Environmental Assessment of Nanaimo Port Alternatives. Summary Report.* Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1974. 63 pp.

Environment Canada. *Preliminary Environmental Effect Assessment, Superport Development, Prince Rupert Region. Volume I: Summary Conclusions and Recommendations.* Environment Canada, Fisheries Service (Ottawa K1A 0H3), 1973. 23 pp.

Conducted over a 4-week period, this preliminary assessment determined potential port sites, identified current environmental data, pinpointed environmental problems, rated the sites environmentally, and recommended further investigation.



The metropolitan transportation planning process (Creighton)

Environmental Assessment Panel. *Alaska Highway Pipeline: Report of the Environmental Assessment Panel.* Environment Canada, Federal Environmental Assessment Review Office (Ottawa K1A 0H3), July 1977. 55 pp. Free.

This interim report examines selected socio-economic and environmental effects of the Yukon portion of the Alaska Highway Pipeline project proposed by Foothills Pipe Lines (Yukon) Ltd. It concluded that the pipeline could be constructed and operated in an environmentally acceptable manner provided that certain conditions were met (proper environmental planning, re-routing around sensitive areas, mitigation in ice-rich permafrost areas). Specific recommendations are made on various routes and associated projects. See also the 1978 report of the inquiry, headed by Kenneth M. Lysyk and appointed by the Minister of Indian and Northern Affairs, *Alaska Highway Pipeline Inquiry,* Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), 1977, $4.50.

Environmental Assessment Panel. *Report of the Environmental Assessment Panel: Shakwak Highway Project.* Environment Canada, Federal Environmental Assessment Review Office (Ottawa K1A 0H3), June 1978. 60 pp. Free.

The Shakwak Highway Project involves paving and upgrading the Haines Road from the Alaska/B.C. border to Haines Junction, and the Alaska Highway from Haines Junction to the Yukon/Alaska border, a total of some 520 km, to be constructed over 11 years (1978-1989) at an estimated cost of $200 million. The Panel reviewed the environmental and social implications of the project, received briefs and conducted hearings in Yukon communities, and concluded that there were no over-riding environmental or social concerns that should prevent the project from proceeding, provided that certain preventive and mitigating actions were taken.

Environment Canada, Fisheries and Marine, Small Craft Harbours Branch. *Initial Environmental Evaluation, Commercial Fishing Harbour, Steveston, B.C.* The Branch (1090 West Pender St., Vancouver V6E 2P1), 1976. 50 pp. + app.

Field, R.E. et al., "Water Pollution and Associated Effects from Street Salting", *Journal of Environmental Division* (American Society of Civil Engineers), 100, 1974, pp. 459-477.

Finsterbusch, Kurt. *A Methodology for Social Impact Assessments of Highway Locations.* Brooklandville, MD: Maryland Dept. of Transportation, 1976. 98 pp. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), PB-259 820, $6.50.

Outlines the steps in assessing the social impacts of alternative highway locations, reviews these impacts, presents procedures for their evaluation and develops social criteria for locating highways.

Glazebrook, G.P. de T. *A History of Transportation in Canada, Volumes 1 and 2.* Toronto: McClelland and Stewart, 1964. Paperback, 191 pp. and 293 pp. $3.50 each.

Greiner, John M. et al. *Monitoring the Effectiveness of State Transportation Services.* U.S. Dept. of Transportation, Office of the Assistant Secretary for Policy, Plans and International Affairs (Washington, DC 20590), Report No. DOT-TP1-10-77-23, 1977. 164 pp. Free.

Grenier, P. et Lagacé, M. *Étude de l'impact sur la faune et son habitat, Autoroute 51, section Melbourne-Ulverton.* Québec Ministère du tourisme, de la chasse et de la pêche (Division des études d'impact, 9530 rue de la Faune, Orsainville, Qué. G1G 5E5), 1977. 58 pp.

This report presents an evaluation of the impact on wildlife of a 40 km section of Autoroute 51. Planning for the proposed route did not give sufficient consideration to wildlife.

Horowitz, Joel and Kuhrtz, Steven. *Transportation Controls to Reduce Automobile Use and Improve Air Quality in Cities.* U.S. Environmental Protection Agency, Office of Air and Waste Management (Washington, DC 20460), EPA-400/11-74-002, November 1974. 69 pp.

This report covers the need for transportation controls, the need for and methods of reducing automobile use, transportation control regulations, economic and social effects of reducing auto use, and the relationship of transportation controls to other aspects of transportation planning and decision-making. Appended are a state-by-state summary of the status of transportation control plans, preambles to indirect source regulations, and a proposed Clean Air Act amendment for transportation control plans.

Jones, Ian S. *Urban Transport Appraisal.* London, Ont.: Macmillan Press, 1977. Paperback, 144 pp. $5.00.

Jones outlines the main elements of the appraisal process, discusses the broad characteristics of the demand for transport, and shows how these characteristics have determined the way travel behaviour is analyzed. He continues by describing the components of the forecasting process in more detail and shows how demand and supply factors are brought together in the benefit estimation process. Part 2 covers evaluation with chapters on the benefit algorithm, evaluation criteria and their implication, problems in evaluation, and the validity of the appraisal process. Environmental concerns are not dealt with directly.

Krzyczkowski, Roman et al. *Joint Strategies for Urban Transportation Air Quality and Energy Conservation, Vol. 1: Joint Action Programs.* Washington, DC: Urban Mass Transportation Administration, Environmental Protection Agency and Federal Energy Administration, January 1975. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161).

Six goals for the three agencies are set out: improved auto alternatives, improved vehicular flow, reduced auto use, reduced travel demand, reduced vehicular emissions, and reduced vehicular petroleum consumption. The impact and inter-relationships of specific strategies and actions are examined with reference to each goal.

Llewellyn, Lynn et al., "The Role of Social Impact Assessment in Highway Planning", *Environment and Behavior*, Vol. 7, No. 3, Sept. 1975, pp. 285-306.

Manufacturing Chemists Association. *Guidelines for Preparation for Shipment of Small Packages of Hazardous Materials.* The Association (1825 Connecticut Ave. NW, Washington, DC 20009), 1977. 11 pp. Free.

McEvoy, James III and Dietz, Thomas (eds.). *Handbook for Environmental Planning: The Social Consequences of Environmental Change.* New York: Wiley, 1977. Hardcover, 323 pp. $25.75.

Chapter VI, pp. 201-240, is "Social Impacts of Transportation" by R. Daniel Schott. Four case studies present social impacts of the Bay Area Rapid Transit System, the Washington DC Capital Beltway, the Interstate highway through Baltimore, and a freeway in Oakland-Worcester.

Morofsky, Edward. *Sensitivity Ratings as a Guide in Locating and Evaluating Transportation Routes and Corridors.* Environment Canada, Forest Management Institute (396 Cooper St., Ottawa K1G 3Z6), Information Report FMR-X-101, 1977. 70 pp. Free.

This report attempts to incorporate environmental data, particularly terrain sensitivity to disturbance, into an automated route location and evaluation system for linear engineering structures. The routing procedure presented here does not promise an optimal route since it is based on the sequential examination of local data. But it does allow flexibility in generating alternate routes under varying constraints integrating engineering, financial and environmental data.

Murray, Donald M. and Ernst, F.W. *An Economic Analysis of the Environmental Impact of Highway Deicing.* U.S. Environmental Protection Agency, Office of Reseach and Development (Washington, DC 20460), 1976.

Odum, Eugene P. et al., "Totality Indices for Evaluation Environmental Impact: A Test Case – Relative Impact of Highway Alternates", in Blissett, Marian (ed.). *Environmental Impact Assessment.* New York: Engineering Foundation, 1976. Hardcover, 278 pp. (Copy can be obtained from Program Manager, Division of Intergovernmental Science and Public Technology, National Science Foundation, 1800 G St. NW, Washington, DC 20550).

Ontario Ministry of Transportation and Communications. *Highway 7 Feasibility Study, Kitchener to Guelph.* The Ministry, Project Planning Branch (1201 Wilson Ave., Downsview, Ont. M3M 1J8), 1975. 9 pp. Free.

A booklet that demonstrates the Ministry's approach (at that time) to environmental assessment of highway route locations with public participation.

Ontario Ministry of Transportation and Communications. *Provincial Road Program, Class Environmental Assessment: B1. Widening of an Existing Highway - Rural (added through traffic lanes).* The Ministry (1201 Wilson Ave., Downsview, Ont. M3M 1J8), 1977. 48 pp.

The first (and, so far, only) example of a "class environmental assessment" under Ontario's Environmental Assessment Act. This one deals with provincial road projects where an existing rural highway is widened by the addition of through traffic lanes. The report describes the general nature of an undertaking which would be included in this Class and the types of problems the undertaking would remedy, then outlines in general terms what an environmental assessment would entail. The highway design process is generalized for projects in this Class and associated environmental investigations and public improvement are spelled out.

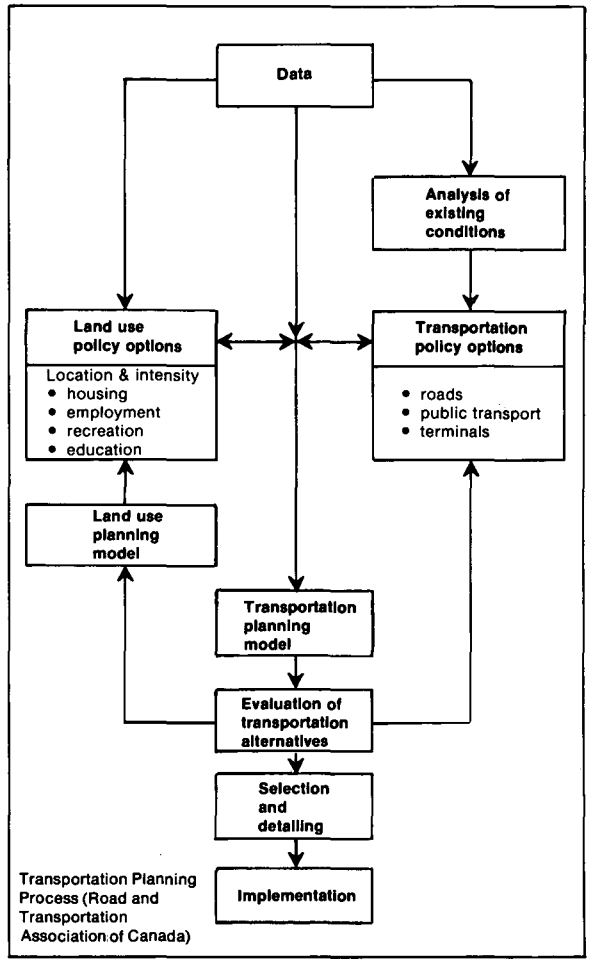
Organization for Economic Cooperation and Development. *Effets de la circulation et des routes sur l'environnement en zones habitées.* OECD (2 rue André Pascal, 75775 Paris, CEDEX 16, France), 1973.

Deals with problems and methods of evaluating environmental externalities of transportation systems.

Roads and Transportation Association of Canada. *Urban Transportation Planning Guide.* Toronto: University of Toronto Press, 1977. Hardcover, 167 pp. $20.00.

Designed as a summary of currently applied techniques and procedures for planning transportation facilities in urban areas in a primarily North American context.

Sartor, J.D. and Boyd, G.B. *Water Pollution Aspects of Street Surface Contaminants.* U.S. Environmental Protection Agency, Office of Research and



Development (Washington, DC 20402), 1972.

Scheidt, Melvin E., "Environmental Effects of Highways", *Journal of the Sanitary Engineering Division* (American Society of Civil Engineers), Oct. 1967.

Silver, M.L. and Bell, L.S. *Aesthetic and Environmental Considerations in the Design of Elevated Transportation Structures.* Washington, DC: U.S. Dept. of Transportation, 1975. 122 pp. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), PB-263 158, $7.25.

This report addresses issues related to assessing or anticipating visual impacts of elevated transportation structures in urban settings. Two alternate approaches are outlined: a compatability matrix approach cross-references characteristics of an existing or proposed structure with features of a specific setting to identify conflicts; and the case study approach graphically portrays each setting with and without the structure in place to illustrate comparative changes. Nine case studies are presented, various ways to improve existing structures are discussed, and recommendations are offered for planning new elevated structures to limit their adverse impacts.

Skidmore, Owings and Merrill et al. *Environmental Assessment Notebook Series.* Washington, DC: U.S. Dept. of Transportation, 1975. Seven-volume set. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock 050-000-00109-1, $21.00 + 25% outside U.S.A.

Technical resource manual for use by people in highway administrations responsible for transportation planning and environmental impact assessment. Seven volumes and a summary, including:
Notebook I: *Identification of Transportation Alternatives* (EIA and transportation planning; overview of transportation planning methods for creating alternatives, case studies). 126 pp.
Notebook II: *Social Impacts* (community cohesion; accessibility of facilities and services; displacement of people). 140 pp.
Notebook III: *Economic Impacts* (employment, income and business activity; residential activity; effects on property taxes; regional and community plans and growth; resources). 204 pp.
Notebook IV: *Physical Impacts* (environmental design, aesthetics and historic values; terrestrial ecosystems; aquatic ecosystems; air quality; noise and vibration). 301 pp.
Notebook V: *Organization and Content of Environmental Assessment Materials* (techniques for presenting environmental assessment data and analysis; detailed impact assessment documents; summary impact assessment documents). 63 pp.
Notebook VI: *Environmental Assessment Reference Book* (glossary; 120 page annotated bibliography; EIA – legal and adminstrative requirements). 209 pp.

Statistics Canada. *Human Activity and the Environment.* Statistics Canada, Office of the Senior Adviser on Integration (Ottawa K1A 0T6), 1978. 183 pp. $2.80 ($3.40 outside Canada).

Transportation is covered in Chapter V. Table 5.37, p. 96, presents population affected by airport noise in selected metropolitan areas.

Stringer, Peter and Wenzel, H. (eds.). *Transportation Planning for a Better Environment. Proceedings of a Conference on Transportation and Urban Life, Munich, September 15-19, 1975.* New York: Plenum Press, 1976. 439 pp.

Urban Transportation Development Corporation Ltd. *Moving Into an Energy Efficient Society.* UTDC (20 Eglinton Ave. W, Toronto M4R 1K8), November 1976. 50 pp. + app.

This submission to Ontario's Royal Commission on Electric Power Planning discusses energy in the provincial economy, energy efficiency in city design (with particular reference to urban transportation), a strategy for energy savings in the crucial period 1976-1991, a choice of futures based on two scenarios (a low 25% modal split and a high 45% level of transit usage in the larger cities), the electric power impacts of choosing the second scenario, and the benefits thereof. Recommendations emphasize high priority on lessening the dependence on oil, accelerating public transit investment, coordinating it with public decisions affecting long-range electric power demand and energy consumption patterns, and federal-provincial efforts toward energy-efficient urban forms.

U.S. Environmental Protection Agency and Corps of Engineers Technical Committee on Criteria for Dredged and Fill Material. *Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters.* Environmental Effects Laboratory, U.S. Army Engineer Waterways, Experiment Station (Vicksburg, Miss.), July 1977. 123 pp.

A manual for implementation of Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 which specifies that all proposed operations involving the transportation and dumping of dredged material into ocean waters must be evaluated to determine the potential environmental impact of such activities. The manual contains summaries and discussions of the procedures for ecological evaluation of dredged materials, tests to implement them, definitions, sample collection and preservation procedures, evaluative procedures, calculations, interpretive guidance and supporting references for evaluation of permit applications. Criteria for these environmental evaluations are provided in: Environmental Protection Agency, "Ocean Dumping: Final Revision of Regulations and Criteria", Federal Register, January 11, 1977, pp. 2 462-2 490.

U.S. Dept. of Transportation. *Social and Economic Effects of Highways.* U.S. Dept. of Transportation, Federal Highway Administration, Socio-Economic Studies Division (Washington, DC 20590), 1974. Paperback, 180 pp.

Conclusions reached in this report include: residents displaced by highways are satisfactorily relocated; some residents suffer an uncompensated lowering in property values because of proximity to highways; the positive effects of accessibility often outweigh the negative effects of proximity, even for residential property; and whether benefits or disadvantages occur near highways depends primarily on the land use involved. Contains a discussion of possible solutions to land use planning problems near highways and includes abstracts of 76 highway impact studies. See also: U.S. Dept. of Transportation, *1975 Supplement to Social and Economic Effects of Highways, 1974*, paperback, 25 pp.

Vancouver International Airport Planning Committee. *An Environmental Impact Assessment of the Vancouver International Airport Expansion Proposals. A Summary Report.* Environment Canada, Lands Directorate (1001 West Pender St., Vancouver V6E 2M7), January 1976. 91 pp. Free.

This report synthesizes the technical findings of an interdisciplinary inter-agency study group established in 1973 as a subcommittee of the Vancouver International Airport Planning Committee. It provides ecological information on the Fraser River Estuary/Delta; documents the competing and often conflicting resource uses, environmental issues and accelerating pressures for continuing manmade developments on this unique resource; reviews current environmental problems associated with present use of Sea Island (where the International Airport is located) and adjacent land and water areas; addresses environmental impacts that would result from Airport expansion; recognizes the need for a comprehensive approach to management of the Estuary/Delta; and makes a series of recommendations for resolving land-resource problems (the first recommendation is a moratorium on further major construction in the area, including expansion of Vancouver International Airport). See also: Airport Planning Committee. *Final Report*, March 1976, 121 pp., which concluded that a decision should be taken not to proceed with the third runway on the basis of the development proposals submitted.

Voorhees, Alan M. & Associates. *Baltimore Regional Environmental Impact Studies.* Interstate Division of Baltimore City, March 1974. Price and availability uncertain; check with Voorhees and Associates (McLean, VA 22101).

This extensive EIS comprises seven volumes: 1. Socio-economic Land Use Analysis; 2. Travel Simulation and Traffic Analysis; 3. Air Quality Analysis; 4. Water Resource and Solid Waste Analysis; 5. Noise Analysis; 6. Analysis of Environmentally Sensitive Areas; and 7. Summary Analysis and Evaluation.

Voorhees, Alan M. & Associates. *Guidelines to Reduce Energy Consumption Through Transportation Actions.* Washington, DC: Dept. of Transportation, Report No. UMTA-IT-06-0092-74-2, May 1974. Paperback. 47 pp. + app. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161).

Various types of low cost, short-term transportation actions are summarized and their potential for reducing energy consumption is estimated.

Voorhees, Alan M. & Associates, et al. *A Guide for Reducing Air Pollution Through Urban Planning.* U.S. Environmental Protection Agency, Office of Air Programs (Washington, DC 20460), 1971.

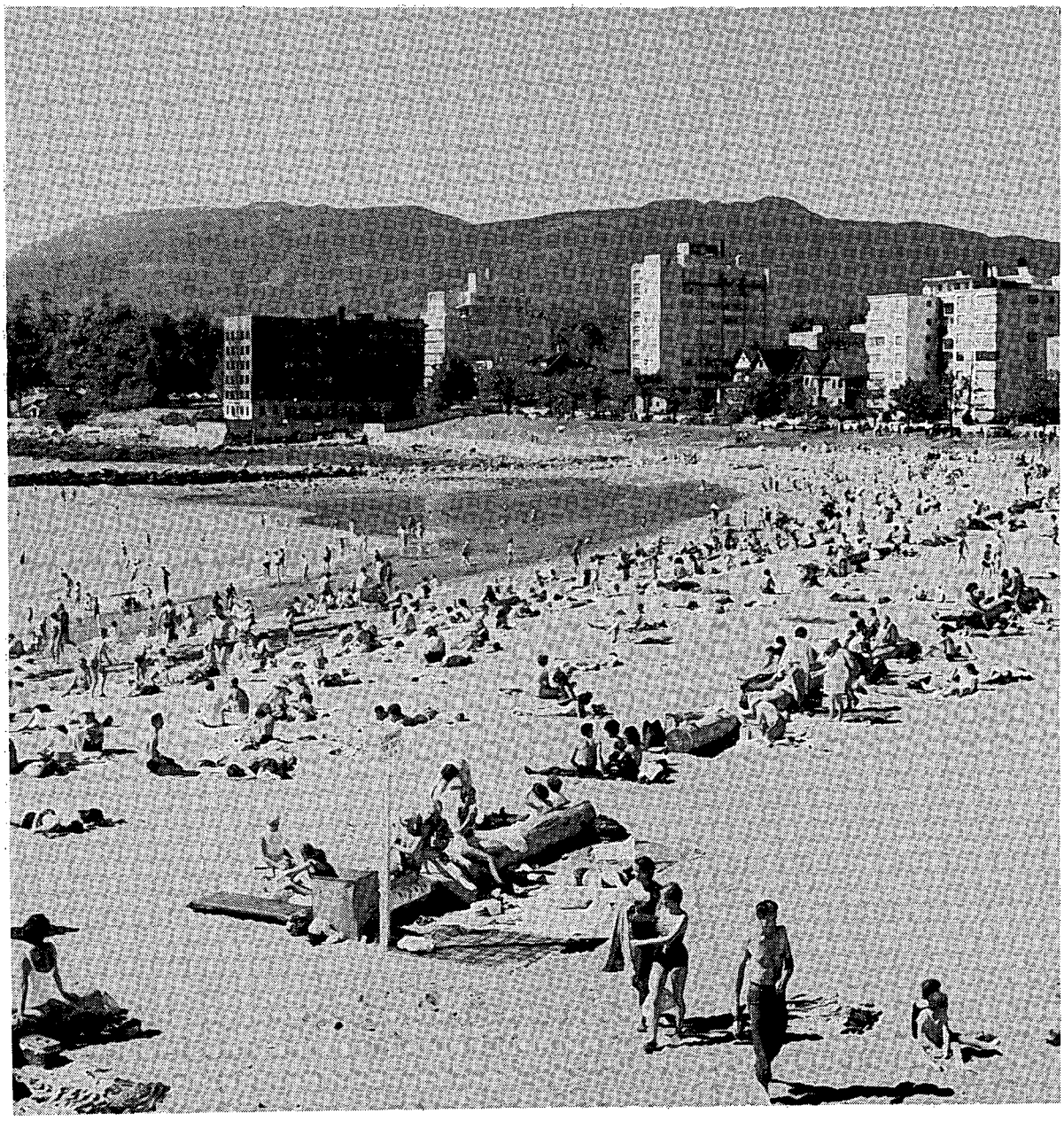
Annotated in 4.2 Urbanization.

Winters, Tobey L. *Deepwater Ports of the United States: An Economic and Environmental Study.* New York: Praeger, 1972. $20.00.

Winthrop, S.O. *Air Pollution in the Urban Environment.* Environment Canada, Environmental Protection Service (Ottawa K1A 0H3), 1973. 11 pp. Free.

4.6 Recreation

Much of the outdoor leisure time activity in which people engage takes place in land or water based environments. It requires certain qualities *from* these environments – or at least the presence of certain environmental attributes, such as fish to catch or birds to watch – to ensure a desired level of recreational experience. At the same time recreation may have certain adverse impacts *on* these environments. Exceeding either the natural or perceptual carrying capacities of an environment will diminish its recreational-resource value. It may seem therefore that it is in the interest of recreationists to also be environmentalists. Unfortunately, ease of mobility allows people to search for new environments when old ones become degraded; and the wide range of types and levels of recreation available, plus human adaptability to changing environmental conditions, enables us to seek out new recreational experiences when old ones prove unsatisfying. And so, environmental planning and management interventions become necessary, from both environmental and recreational perspectives, on behalf of present and future populations of human and nonhuman life.



Acknowledgements 4.6

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Pressures on recreational environments have been increasing rapidly in recent years. Contributing factors include population growth, proportional increases of younger people, more leisure time and disposable income, the elasticity of recreation expenditures (as income rises, a greater percentage tends to be spent on recreation), rising education levels, new technology such as all-terrain vehicles and active promotion of its use through "lifestyle" advertising that exploits back-to-nature values, increased accessibility of recreational areas, and aggressive governmental encouragement of tourism. While increases in energy costs will alter some of these trends and put more emphasis on recreation nearer population concentrations, the immediate future seems to promise continued growth in present recreation demand. Indications are that a large *deferred* demand now exists with many people wanting to participate in recreation but unable to do so because of inadequate facilities or poor information (as opposed to the *potential* demand of those who lack the necessary time and money). Supply of recreational land is not keeping pace with demand. Degradation threatens the current stock of recreational areas – Banff and Lake Louise, for instance – because of difficulties in rationing their use to prevent carrying capacities from being exceeded. It may soon be necessary to divert large numbers of recreationists away from amenity resources which used to be considered synonymous with recreation. Prevailing economic conditions inhibit direct government intervention to relieve the problem by preparing more public land for recreation and establishing new facilities.

Recreation is oriented and related both to urban and rural/wilderness areas. Inadequate recreational opportunities in the city will create more pressure on the countryside or wilderness, and excessive urban housing costs cause people to locate in the country and commute or convert summer residences to year-round living. Conversely, urban activities can sometimes open up new recreational opportunities; waterfront landfill operations may create park sites and wildlife habitats (as is the case in Toronto) and formerly derelict land may find new uses for play areas. Recreation has to be seen in the context of its relationships to other components of urban and regional systems, and available opportunities to increase recreational opportunities need to be exploited. Otherwise, potential adverse social, economic and environmental consequences will become realities.

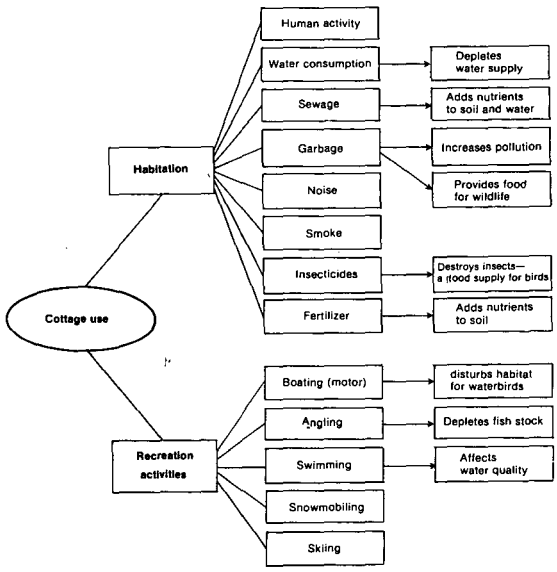


Figure 4.9 Environmental Impacts of Cottage Use

Source: Ontario Ministries of Environment, Housing and Natural Resources, *Lakeshore Capacity Study, Progress Report* (Toronto: Ministry of Housing, Local Planning Policy Branch, Feb. 1978).

The adverse environmental impacts of recreation include:

Air, water and soil pollution. Water and soil pollution come mainly from improper septic tank disposal systems, large or small (most recreational developments are on lakes, rivers, streams or oceans). Use of fertilizers, herbicides and pesticides (e.g. on golf courses) is also a factor. Air pollution is mainly the result of heavy traffic in and out of major recreational areas. Litter and solid waste disposal are major problems. People often use streams and lakes in recreation areas as convenient receptacles for garbage, picnic leftovers, abandoned automobiles, and all manner of waste.

Damage to existing flora and fauna. Plants are trampled, young trees are cut for firewood, flowers are picked, animals are fed, "nuisance animals" (beavers, skunks, racoons, bears, etc.) are killed or removed, wild animals are disturbed by children and pets, facilities are erected with accompanying land clearing, careless human activities cause forest fires, habitats are destroyed. All these are normal consequences of concentrated recreational activities. Alteration to habitats or food chains, intolerance to human behaviour and introduction of exotic species may lead to fundamental changes in species composition.

Soil and snow compaction. Machines and pedestrian traffic compact the soil, alter its runoff characteristics and affect its capacity to sustain life; certain areas, such as alpine meadows, are particularly vulnerable. Snow compaction, caused mainly by snowmobiles and cross-country skiing, reduces snow depth and increases frost penetration with consequent damage to plant life.

Erosion and groundwater changes. Careless siting and construction, especially in relation to seasonal residences and large-scale developments (such as the building of a ski run) remove topsoil, increase the rate and amount of runoff, cause sedimentation, alter aquatic regimes, upset the hydrologic cycle, contribute to flooding and scar the landscape.

Visual blight. Negative environmental effects are most easily experienced visually. Loss of amenity values diminishes the entire recreational experience for many people (not all of them unfortunately). It is often impossible to reverse.

Noise. Trail bikes, snowmobiles and construction equipment (especially the chain saw) are primary offenders. A cruising snowmobile emits 85-95 decibels at 50 feet, the equivalent of a dump truck travelling at 50-60 mph. Noise adversely affects certain recreational experiences (while enhancing others, such as stock-car racing). The problem is largely one of compatability and separation. Noise also has a detrimental effect on nonhuman life, the presence of which is often an intergral part of the overall recreational experience.

Environmental impacts tend to increase with the number of users, but seldom linearly. Impacts such as soil compaction and loss of groundcover are more severe in the early stages. Concentration of users in space and time causes greater impacts than an equal amount of dispersed use; the impacts of large recreational complexes is of particular concern. Mechanized recreation also increases impacts because a machine can travel much farther and has greater unit impact (more weight, wheel churning) than a person.

The indirect effects of recreation can also adversely affect the environment by causing development where none would have occurred or by speeding it up. Ski slopes attract chalets, lakes and ocean shorelines attract cottages, beaches attract hotels and motels, parks attract cars which need roads plus servicing facilities and a place to park; all attract food, supply and service establishments. Indirect effects are often social in nature – communities disrupted by a new major park, pressures imposed on people who make their living from tourism, and the lifestyle changes that occur when a previously remote community suddenly becomes accessible to affluent outsiders whose interests are narrowly defined and whose stay in the area is brief. The "causal factors" are not always tourists. For example, evidence suggests that the *main* threat to agriculture and farm communities in close proximity to cities is the non-farm use of land by people seeking a rural-recreational lifestyle (Bureau of Municipal Research).

Part of the environmental planner's problem is that planning for recreation has been functionally separate from other forms of land-based planning in governments at all levels. Comprehensive viewpoints and coordinated plan and policy formulation are difficult to achieve. Another problem is that land classification systems, with the appropriate information at the required scale, are not generally suited to the needs of recreation planning. Also, conflicts occur between recreation planners, oriented to recreation needs and activities, and urban/regional planners who tend to rely on arbitrary standards (so many acres of open space and parkland per 1 000 population, 5% of the developer's land). Criteria, standards, methods and guidelines developed for urban areas have only limited relevance to rural recreation planning.

At the management level, on both urban and rural scales, integrated recreation-oriented and environmentally sound action are equally difficult to achieve, as planners with Ontario's Conservation Authorities (to cite one case) can attest. Pressure exists to make all recreational areas publicly accessible and to turn them into featureless plains of well-mowed grass. Organizational structures, designed to facilitate the fulfillment of specific objectives, also institutionalize bias and internalize conflict. Recreation is commonly fragmented among dozens of government agencies; it may be combined with tourism and industrial development, or with natural resources. And recreation is used by various departments to justify facilities aimed at other purposes; pleasure driving, claimed to be a prime form of recreation, validates the building of more highways and promised recreational

benefits help make the case for dam construction. The functional approach itself reduces the level of social and ecological concern. Meanwhile, the basic problem, a shrinking land resource as well as increasing recreational demands, remains.

Case Study 69
Biophysical Inventory,
P.E.I. National Park
Submitted by Michael Simmons,
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The National Park is a thin strip of shoreline that includes barrier beaches and rocky headlands on the Island's north coast. Intensive recreational development (highway access, parking, beach facilities, large campgrounds, etc.) have begun to deteriorate the resources which the Park was created to protect. Parks Canada commissioned a biophysical inventory in 1972 to provide an information base for action to address these problems. Maps 100 years old and 35-year old airphotos indicate enormous changes in the Park. A large storm in 1923 penetrated up to a half-mile inland, severely eroding existing dunes and creating new ones. Most of this sand is now again stabilized by vegetation, making the biophysical inventory worthwhile (landforms and vegetation associations correlate well even at large scales of investigation).

Substantial modification of the Park environment was revealed by the inventory. The highway, by interrupting natural processes, has particularly altered biophysical units; the consultant, though not obliged to make recommendations on this contentious issue, suggested removal of four sections of highway. Recreation activities, however, have had only slight impact. No "blowouts" attributable to human activity were observed although there are many unsightly breaks in the ammophila vegetation of the dunes. Natural processes in this environment are so strong that most attempts at modification fail or produce large-scale unintended side effects.

The biophysical inventory provides information needed to fit recreational developments into this rapidly changing environment. Subsequent studies by Parks Canada are attempting to follow through on this approach but its effectiveness cannot yet be evaluated.

Refer to:
Parks Canada, *Biophysical Inventory and Process Analysis, P.E.I. National Park, 1975.* The consultant was Eastern Ecological Research Ltd. (Box 1130, Truro, N.S.).

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Case Study 70
Wapiti-Grande Prairie Sand Dunes

The ecologically fragile Wapiti-Grande Prairie Sand Dunes are located south of the City of Grande Prairie on crown-owned land. Because of their uniqueness to the region and proximity to Grande Prairie the dunes represent a significant recreational resource. Other land uses in the area include sand and gravel extraction, agriculture and peat extraction.

The Public Lands Division of Alberta Energy and Natural Resources lacked the data and resource management guidelines necessary to assess the environmental implications of lease applications for differing types of land use and to appraise development permits for the area. To fill this gap, the Resource Evaluation and Planning Division prepared an integrated land use management plan for a portion of the Wapiti-Grande Prairie Sand Dunes. Ecological (Biophysical) Land Classification, at a scale of 1:15 840, provided a means of dividing the landscape into Ecologic Planning Units. The Ecological Land Classification for the Wapiti-Grande Prairie Sand Dunes area was limited to *Land Systems* (three were identified for the area: an aeolian plain, organic terrain and a river valley) and *Land Types* (as well as soil, pattern of slope and internal drainage were used to differentiate between the Land Types). The Land Type interpretations provided indicators of predicted response under different land uses but not use recommendations. A *use-limitation table* indicating the severity and types of limitations to recreational land uses common to the area was developed to accompany the ELC. To aid in the planning of the Wapiti-Grande Prairie Sand Dunes area, Land Types with similar use-limitations for the same land use were grouped together into *Ecologic Planning Units.*

This information was incorporated into an *ecological land use matrix* which indicated possible land use activities within various Ecologic

Planning Units and that formed the basis for the preparation of the management plan. Taking into account three objectives – maximizing recreational potential, minimizing environmental impact, and meeting land use needs of industry and municipal and public utilities – the planning team allocated seven types of land use in the Dune area: conservation, non-facility recreation, facility recreation, municipal and public utilities, industrial park, sand and gravel extraction, and private land.

Refer to:
D.O. Luff and P.M. Ojamaa, *The Value of Ecological (Biophysical) Land Classification in Land Use Planning: An Alberta Case Study*, Alberta Energy and Natural Resources, Resource Evaluation and Planning Division, 1978.

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Case Study 71
Port Aberdeen, Ontario: Environmental Planning for a New Recreational Community
Submitted by Cameron Kitchen, Ecoplans Ltd.

Port Aberdeen is a new recreational comunity (10 000 people, 3 200 dwelling units) proposed for a 1 500 acre site on Pigeon Lake in Harvey Township in north-central Ontario. The complete range of recreational opportunities proposed includes an 18-hole golf course, equestrian centre, marina, ski-hill and tennis courts.

The proposal raises several environmental issues: enrichment of Pigeon Lake, boat capacity of the lake, fishing stress, building and maintenance affecting inland lakes, shoreline development and effects on forest and wildlife resources. The developer voluntarily submitted the proposal to environmental assessment. A report was filed in February 1975; approval in principle was finally forthcoming a year and a half later. Use of a core design team, including two ecologists, facilitated integration of environmental concerns with ongoing planning, resulting in an environmentally sensitive design. Special conditions affecting the planner's work included the lack of firm guidance from the Province in preparation of the environmental impact statement, a policy vacuum regarding major recreational development in the Kawartha Lakes region, and a local council concerned about being overwhelmed by a project of this scale.

The Port Aberdeen Recreational Community provides a useful example of environmental planning for a major development of this type. It also illustrates the administrative and other problems such a development may encounter.

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Information Resources

See also:
2.7 Natural Systems and Processes
3.5 Scenic Areas
3.6 Environmentally Sensitive Areas

American Society of Planning Officials et al. *Subdividing Rural America: Impacts of Recreational Lot and Second Home Development – Executive Summary.* Washington, DC: Council on Environmental Quality, 1976. 24 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 040-000-00358-4, $0.75 + 25% outside U.S.A. (minimum mail order: $1.00).

This study was to assess and suggest possible remedies for the problems associated with the environmental, economic and social impacts of second home developments and recreational lot sales. It concludes that such impacts are potentially significant but can mostly be ameliorated if developers and government officials work together in the careful planning and development of such project. This report summarizes five detailed studies: 1. *Subdividing Rural America: Impacts of Recreational Lot and Second Home Developments*, 1976; 2. *Recreational Lot and Second Home Development: A Manual for Reviewing Impacts*, 1976; 3. *Recreational Properties: An Analysis of the Markets for Privately Owned Recreational Lots and Leisure Homes*, 1974; 5. *Recreational Properties in Appalachia*, 1974; and *The Subdivision of Virginia's Mountains: The Environmental Impact of Recreational Subdivisions in the Massanutten Mountains – Blue Ridge Area, Virginia*, 1974. Reports 1 and 2 are available from U.S.G.P.O. Reports 3 and 4 can be obtained from the National Technical Information Service (5285 Port Royal Rd, Springfield, VA 22161). Report 5 is available from the Conservation Foundation (1717 Massachusetts Ave. NW, Washington, DC 20036).

Balmer, Crapo and Ross, Inc. *Tourism Development in Ontario: A Framework for Opportunity.* Ontario Ministry of Industry and Tourism (900 Bay St., Toronto M7A 2E1), 1976. 2 volumes.

Covers the economic, social and environmental impacts of tourism, listing under each of these headings the advantages of tourism/recreation (e.g. generates interest in and awareness of significant natural features), its disadvantages (such as the possible despoilation of shorelines, lakes and other resources with high recreational potential) and means of overcoming the disadvantages (e.g. conduct capability studies in areas of high recreational potential to determine acceptable levels of use and to establish necessary controls). Shown as factors which usually influence the direction and magnitude of economic, social and environmental impacts are: geographic size of the planning area; economic development of the destination area; strength of the local culture; environmental characteristics of the destination area; seasonality; degree of local involvement in planning and development; spatial characteristics of the proposed development; extent to which tourism depends on community facilities; the required rate of growth of the tourist facility; the number of visitors and size of the resident population; length of stay of visitors; their socio-economic status; and visitor ethnic characteristics.

Barasch, S.B. *Recreational Planning for New Communities.* New York: Exposition Press, 1974. 54 pp. $5.00.

Seeks to analyze the differences in recreational planning for communities with different characteristics on the demand side, especially age and income. The model developed in the book is applied to the new community of Woodlands near Houston (described in 5.4 Plans).

Barton, Noreen. *Towards a Cottage Policy for Ontario.* University of Waterloo (Waterloo, Ont. N2L 3G1), 1974.

Unpublished M.A. thesis.

B.C. Land Commission. *Open Space: An Inventory of Opportunities.* Dept. of Recreation and Conservation, Information and Education Branch (512-514 Fort St. Victoria, B.C.), 1976. Free.

This "Handbook for Community Groups and Public Authorities" presents an inventory of agencies in British Columbia, the types of open space they serve ("open space" means land or water used for outdoor recreation, or in need of protection for various conservation reasons, usually open for public access), and the legislative and other devices used in open space creation and preservation.

B.C. Ministry of the Environment. *Outdoor Recreation Resources of the Northeast Coal Study Area, 1976-1977.* The Department, Resource Analysis Branch (Parliament Buildings, Victoria V8V 1X4), December 1977. 71 pp. + app.

Part of a larger set of studies for the Area (see 4.4 Resource Development), this report contains a regional description of the Area's climate, a description of the natural features which comprise the outdoor recreation resource, an inventory of the recreation facilities in the Area, an outline of present and potential outdoor recreation activities, a discussion of possible impact of coal-related development on the resource, and recommendations for its management. A subsequent volume, *Outdoor Recreation Resources of the Northeast Coal Study Area, 1977-1978*, is in preparation. See also Block and Hignett.

Block, H.G. and Hignett, V. *Recreation Capability Inventory. Draft.* B.C. Ministry of the Environment, Resource Analysis Branch (Parliament Buildings, Victoria V8V 1X4), 1976. 64 pp.

This two-step mapping approach, which has replaced use of the Canada Land Inventory outdoor classification system in British Columbia, involves: 1. mapping of *recreation features* including biotic (fish, wildlife, plants), physical geographic (waterfalls, glaciers, springs, rock formations), water (beaches, harbours) and cultural (archaeological and historic sites); and 2. mapping of *recreation carrying capacity* (the inherent ability of land units to sustain recreational use) using biophysical evaluation criteria that include soil texture, soil depth, drainage, surface processes, topography, water body characteristics, vegetation, and fish and wildlife resources. For a regional review of outdoor recreation features, together with an assessment of potential highways, railway and town-development impacts, see B.C. Ministry of the Environment.

Bureau of Municipal Research. *Food for the Cities: Disappearing Farmland and Provincial Land Policy.* BMR (2 Toronto St., Suite 306, Toronto M5C 2B6), June 1977. 94 pp. $4.00

Annotated in 4.1 Agriculture.

Burton, T.L. *Making Mans' Environment: Leisure.* Toronto: Van Nostrand Reinhold Ltd., 1976. 93 pp. $8.95.

A short insightful introduction to the problems of planning for leisure activities.

Butler, George D. *Introduction to Community Recreation.* Third Edition. New York: McGraw-Hill, 1959. Hardcover, 577 pp.

Butler, R.W. and Nelson, J.G., "Recreation and the Environment", in *Perspectives on Environment.* Association of American Geographers, Commission on Col-

lege Geography (1710-16th St. NW, Washington, DC), 1974.

A general review, including an extensive bibliography.

Canadian Outdoor Recreation Research Committee. *Parks and Recreation Futures in Canada.* Ontario Research Council on Leisure (c/o Bill Knott, Ontario Ministry of Culture and Recreation, 77 Bloor St. W., Toronto M7A 2R9), 1978. $6.00.

Among the topics discussed are application of future research techniques to long-range planning and management, limits to growth in recreation participation, and implications of growth limits to alternative standards of provision of parks. Also available from the Council: *The Economic Impact of Parks*, 1975.

Clawson, M. and Knetsch, J. *Economics of Outdoor Recreation.* Baltimore: Johns Hopkins Press, 1966. Paperback, 328 pp. $4.25.

Although somewhat dated this book is a comprehensive treatment of the demand for outdoor recreation, the resources available for recreation, and the economics of recreation. Does not emphasize environmental impacts.

Crowe, R.B., "Recreation, Tourism and Climate – A Canadian Perspective", *Weather*, Vol. 30, No. 8, 1975, pp. 248-253.

Crowe, R.B. et al. *The Tourism and Outdoor Recreation Climate of Ontario. Volume One: Objectives and Definitions of Seasons.* Ottawa: Environment Canada, Atmospheric Environment Service, 1977. Available from Supply and Services (Printing and Publishing, Ottawa K1A 0S9), $2.75. *Volume Two: The Summer Season*, $7.50. *Volume Three: The Winter Season*, $5.00.

A three-volume report prepared to promote the use of meteorological information in recreation and tourist-facility planning.

Fischer, D.N, Lewis, J.E. and Priddle, G.B. *Land and Leisure: Concepts and Methods in Outdoor Recreation.* Chicago: Maaroufa Press, 1974. Paperback, 270 pp. $5.45.

A selection of readings divided into five sections: social values and approaches, patterns of recreational resource use, behavioural aspects of recreation, economics of recreation, and the environmental impacts of recreation. Papers in the latter chapter cover physical and ecological requirements of recreation area planning, campground trampling and ground cover response, soil surveys in recreation planning, silviculture for recreation area management, and a method for inventory and classification of recreational land.

Geological Society of America, Committee on Environment and Public Policy. *The Impacts and Management of Off-Road Vehicles.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), 1977.

Gold, Seymour M., "Recreation Planning for Energy Conservation", *International Journal of Environmental Studies*, Vol. 10, 1977.

Gold, Seymour M., *Urban Recreation Planning.* Philadelphia: Lea and Febiger, 1973. Hardcover, 333 pp.

Horton, J.T., "The Niagara Escarpment: Planning for the Multi-Purpose Development of a Recreational Resource", in Krueger, Ralph R. and Mitchell, Bruce (eds.). *Managing Canada's Renewable Resources.* Toronto: Methuen, 1977. Paperback, 333 pp. $9.95.

See also: The Niagara Escarpment Commission, *Preliminary Proposals*, released early 1978 and annotated in 5.4 Plans.

Hough, Michael. *The Urban Landscape: A Study of Open Space in Urban Metropolitan Areas.* Conservation Council of Ontario (45 Charles St. E., Toronto M4Y 1S2), 1971. 128 pp.

Focusing on the Metro Toronto area, this study determines what open space resources exist, what kinds of recreational functions these resources can or should accommodate, and what means exist to acquire and structure these resources to better serve the leisure needs of an urban population while contributing to improvement of the environments.

Jaakson, Reiner et al., "Carrying Capacity and Lake Recreation Planning: A Case Study from North-Central Saskatchewan", *Town Planning Review*, Vol. 47, No. 4, October 1976, pp. 359-373.

Described as Case Study 41 in 3.3 Lakes. Earlier articles by Jaakson include: 'A Mosaic Pattern of Balanced Land-Water Planning for Cottage Development and Lake Planning', *Plan Canada*, Vol. 14, No. 1, 1974, pp. 40-45; and 'Planning for the Capacity of Lakes to Accommodate Water-Oriented Recreation', *Plan Canada*, Vol. 10, No. 3, 1970, pp. 29-40.

Jubenville, Alan. *Outdoor Recreation Planning.* Philadelphia: W.B. Saunders Co., 1976. Hardcover, 399 pp. $10.00.

A comprehensive text covering the recreation planning process, economics of outdoor recreation planning, method and approaches, guidelines for site and facility planning (with some environmental concern shown), and a "planning information portfolio" which offers a selection of specific planning materials on the subject.

Kaplan, Max. *Leisure Theory and Policy.* New York: Wiley, 1975. Hardcover, 444 pp. $16.00.

Kimmelman, B. et al. *Studies in Environment. Volume V: Outdoor Recreation and the Environment.* Washington, DC: U.S. Environmental Protection Agency, Office of Research and Development, 1974. 91 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $1.40 + 25% outside U.S.A.

This study projects a huge increase in recreational demand and argues that we are ill-equipped to deal with it in terms of either meeting the demand or preventing adverse environmental impacts from overuse of recreational areas. One chapter is devoted to each of outdoor recreation on private lands, in coastal areas and in urban areas. Future trends in recreation are also discussed.

Krutilla, J. *Natural Environments.* Baltimore: Johns Hopkins University Press, 1972. Hardcover, 352 pp. $18.50.

Nine papers focus on various aspects of the natural environment. They tend to be economically oriented, frequently statistical and theoretically formulated but nonetheless of practical significance. Topics include: a treatment of the economics of environmental modification accompanied by a case study, Hells Canyon; the effect of technological change on different uses of environmental resources; wilderness quality, capacity and demand; waterfowl; a quantitative approach to the classification of inland waters; and landscape aesthetics.

Lassey, William R. *Planning in Rural Environments.* New York: McGraw-Hill, 1977. Hardcover, 257 pp. $17.95.

Chapter XI, "Problems of Rural Regional Planning Illustrated: Major Recreation Development", uses Montana's Gallatin Canyon project as a case study (see Stuart, below). The book is annotated further in 1.3 Characteristics of Environmental Planning.

Lundgren, J.O.J., "Environmental Consequences of Mass Tourism in Swedish National Recreational Planning", *Human Environment in Sweden*, April 1978, pp. 1-8.

Describes recent trends in vacation travel and leisure-activity demands in Sweden. Its National Recreational Plan designates 23 "primary recreation areas" covering approximately 9% of the national territory, within less than an hour's travel time for 80% of the country's population. Emphasis is on outdoor recreation; environmental and conservation objectives are secondary. Development of these areas is the responsibility of joint regional planning committees involving both levels of government (Sweden is a unitary state). *Human Environment in Sweden*, a regular newsletter, and the summary report, *Tourism and Recreation in Sweden*, are available from the Swedish Embassy (140 Wellington St., Ottawa K1P 5A2), free of charge (but include a self-addressed mailing label).

Manitoba Dept. of Urban Development and Municipal Affairs, Municipal Planning Branch. *Shoreland Recreation: An Environmental Approach to Development.* The Department (201-116 Edmonton St., Winnipeg R3C 1R2), March 1971. 45 pp.

Summarizes the problem as unanticipated increased public demand for an unavailable resource – undeveloped shoreland. Failure to predict this demand led to government-authorized ownership patterns that neglected design considerations in subdivisions, public reserves, and environmental pollution controls. Past actions (or lack of them) contributed to existing problems. Some of these weaknesses were: absence of a planning system to determine the carrying capacities of Manitoba's waters; deteriorating water and shoreland quality especially from agricultural fertilizers, industrial wastes and domestic effluents; inadequate

provision for public shoreline reserves and parks; development in improper locations; poor design of subdivisions; excessive buildings and docks; competing but incompatible uses; and unsightly mixtures of uses resulting in decreased property values.

Marty, Sid. *Men for the Mountains.* Toronto: McClelland & Stewart, 1978. Hardcover, 270 pp. $12.95.

A career park warden with Parks Canada speaks about his work with great feeling, concern and candour. An example: "To wildly understate the case, the duplicity in high places (to support private developers) has seriously undermined Parks Canada's credibility as a defender of the environment, while the politicians responsible have been transferred to new portfolios, leaving civil servants holding a rather smelly looking bag".

Meyer, Philip A. et al. *Local Perceptions Concerning Recreation in Coquitlam River.* Environment Canada and B.C. Ministry of Recreation and Conservation, 1976.

Annotated in 1.2 Characteristics of Environmental Problems.

National Capital Commission. *Conceptual Plan for Gatineau Park with Preliminary Proposals for Development and Use.* NCC (48 Rideau St., Ottawa K1N 8J5), June 1976. 71 pp. French and English.

The Conceptual Plan is the first step in a planning process which will determine the future role and use of this extensive natural area in the National Capital Region. The document describes: the context; the area's resources; the planning approach used; the analysis of resources for each of the Park's three components – conservation, recreation and interpretation; the concept of multiple use with a balance between these three functions; preliminary proposals for development and use; and recommendations for subsequent phases of planning, acquisition, development, use and management. Accompanying the Conceptual Plan is a technical addendum, *Gatineau Park: Methodology, Inventory, Analysis,* June 1976.

Nelson, J.G., "Canadian National Parks and Related Reserves: Research Needs and Management", in Krueger, Ralph R. and Mitchell, Bruce (eds.). *Managing Canada's Renewable Resources.* Toronto: Methuen, 1977. Paperback, 333 pp. $9.95.

New Jersey Dept. of Environmental Protection, Office of Environmental Review. *Outdoor Recreation in New Jersey: New Jersey Statewide Comprehensive Outdoor Recreation Plan.* The Department (P.O. Box 2809, Trenton, NJ 08625), 1973. 224 pp.

This statewide plan identifies deficiencies in outdoor recreation opportunities in New Jersey and suggests ways to overcome them, promotes access to outdoor areas providing quality recreational experiences, outlines the responsibilities of the various governments and the private sector in the outdoor recreation field, illustrates the need for preserving outstanding scenic/cultural/natural resources, and provides a basis for allocating funds. Recreation needs, projected demand, land and water resources, and recreation and open space facility and services are addressed in detail.

Ontario Research Council on Leisure. *Analysis Methods and Techniques for Recreation Research and Leisure Studies.* Ontario Research Council on Leisure (c/o Bill Knott, Ontario Ministry of Culture and Recreation, 77 Bloor St. W., Toronto M7A 2R9), 1977. 517 pp.

A general guide to analytic techniques, applicable to recreation, which introduces each technique and indicates where further information may be found. The reader will probably need some grounding in statistics.

Regional Science Research Institute. *Untaxing Open Space: An Evaluation of the Effectiveness of Differential Assessment of Farms and Open Space.* Council on Environmental Quality (722 Jackson Place NW, Washington, DC 20036), 1976.

This report evaluates the effectiveness of the various types of differential assessment laws in achieving the goals of tax relief and open space preservation, and it explores some of their secondary impacts especially those concerning tax incidence.

Rodgers, Gordon K. *Recreation in Natural Environments: An Examination of Impacts and the Concept of Carrying Capacity.* York University, Faculty of Environmental Studies (4700 Keele St., Downsview, Ont. M3J 2R2), 1975. 116 pp.

Unpublished major paper; check with the Faculty's Resources Centre.

Sargent, Frederic O. *Rural Environmental Planning.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), 1976. Paperback, 199 pp. $7.00.

See Chapter 10, "Rural Recreation Planning", pages 115-117, and Appendix 3, "Proposed Lakeshore Recreation Site Evaluation System". The book is annotated further in 1.3 Characteristics of Environmental Planning.

Stuart, D.G. *Impacts of Large Recreational Developments Upon Semi-Primitive Environments: The Gallatin Canyon Case Study.* Montana State University, Center for Interdisciplinary Studies (Bozeman, MT 59715), June 1974. 128 pp.

Primitive environments are defined as roadless areas which have wilderness-level recreation but no more; semi-primitive environments have somewhat more development (e.g. a few roads, some logging, the odd house). The study inventoried and monitored several key components (e.g. land, air, water, vegetation, and wildlife) during the development of the Big Sky ski resort. The resort generated considerable development with significant environmental changes and conflicts. See also: Lassey, above; and Gallatin Canyon Study Team, *The Gallatin Area: A Summary Report* (Bozeman, Montana: Montana State University, Cooperative Extension Service, Bulletin 344, February 1974), 37 pp.

Theberge, John B., "Ecological Planning in National Parks," in McBoyle, G.R. and Sommerville E. (eds.). *Canada's Natural Environment: Essays in Applied Geography.* Toronto: Methuen, 1976. Paperback, 264 pp. $8.95.

Examines the need for an ecological approach in the planning of national parks, looks critically at existing practice guided by Parks Canada's *National and Historic Parks Branch System Planning Manual* (1971), and suggests better ecological methods.

Toronto Field Naturalists Club. *Toronto the Green.* The Club (1164 Broadview Ave., Toronto M4K 2S5), 1976. 42 pp.

A survey of natural areas, and to some extent recreation opportunities, in Metropolitan Toronto. A good example of the kind of project possible for citizens' groups (see also the case study in 5.8 Public Participation).

Toyne, P. *Recreation and Environment.* London, Ont.: Macmillan Education Ltd., 1974. 42 pp.

A basic introduction to recreation demand and supply.

University of Guelph, Centre for Resources Development. *Planning for Urban Recreational Open Space: Toward Community Specific Standards.* Toronto: Ministry of Housing, Local Planning Policy Branch, 1976. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $3.00, cheque payable to Treasurer of Ontario.

The major question addressed in this study (prepared by J.R. Wrights, W.M. Braithwaite and R.R. Forster) was whether planning initiatives at the municipal level, in concert with current provincial guidelines and standards in Ontario, were adequate to provide recreational open space of the proper amount, kind and location to meet the needs of urban communities. The report, addressed mainly to planners and managers of urban recreational open space and focusing heavily on residential-related urban open space, deals with two planning situations: established neighbourhoods and newly developing areas, primarily in medium-sized cities and towns. Current planning approaches inadequately address the critical relationship between the physical design of urban recreational open spaces and the functions they are intended to serve, the complex diversity of urban needs involved, the conservation function of open space, and public participation. The report outlines strategies for public involvement in the recreational planning process, identifies biophysical resources deserving consideration, proposes a series of investigations to assess recreational demand, and advocates a "community-specific standards" approach for use by each community in determining and meeting its recreational open space requirements.

Wall, G. and Wright, C. *The Environmental Impact of Outdoor Recreation.* University of Waterloo, Dept. of Geography (Waterloo, Ont.

H2L 2G1), Publication Series No. 11, 1977. Paperback, 69 pp. $5.00.

A review of the physical and ecological impacts of outdoor recreation. Chapters cover geology, soils, vegetation, water quality, wildlife and air. Application of research is discussed with reference to carrying capacity, planning and site management.

Whyte, William H. *The Last Landscape.* Garden City, NY: Anchor Books, 1970. Paperback, 428 pp. $2.75.

The "Last Landscape" is in the metropolitan area where so many people live and will live. The quality and livability of future urban environments will depend a great deal on the way open space is handled. Part One of this book takes up the political realities of open space (the people planning the way it is to be used vs. the people who own and control it, and the rich communities vs. the poor ones) and the main tools for securing open space. Part Two discusses the planning of such spaces – the approach that uses open space chiefly as a means for shaping the planner's plans vs. the view that open space planning should take its cue from the patterns of nature itself. The English greenbelt experience is examined. Part Three turns to urban development and open space and their reciprocal relationship. Cluster development and new towns are assessed. Part Four is about the landscape itself while Part Five covers landscape design and density questions.

Wilkes, Brian D., "The Myth of the Non-Consumptive User", *Canadian Field Naturalist,* Vol. 9, No. 4, 1977, pp. 343-349.

Points out that large groups of recreationists are consumptive along spatial, temporal and physical dimensions. New directions in the planning of outdoor recreation settings are discussed.

Wilkinson, Paul F. *Environmental Impact of Outdoor Recreation and Tourism.* Vance Bibliographies (P.O. Box 229, Monticello, IL 61856), August 1978. 90 pp. $9.00.

An extensive unannotated listing of 887 sources covering general references, economic, ecological/physical, phsychological and social impacts and their analysis.

4.7 Energy Projects

Traditionally Canada, with its cold climate and great distances, has been among the most energy-intensive countries in the world (see Figure 2.41 in 2.7 Energy). The Canadian community of today consumes proportionately even more energy than in the past. Per capita energy consumption, which was fairly steady up to World War II, doubled in the past 30 years. Sudden increases in energy costs have slowed the rate of growth of energy consumption somewhat and they have triggered new concerted efforts to increase the supply. Energy projects – pipelines, hydroelectric dams, oil and gas explorations and recovery, nuclear and coal-fired power plants, uranium and coal mines – are now in the forefront of public attention, consuming huge amounts of capital and posing new environmental threats.

One way or another most of the pollution of land, air and water can be linked to energy use. "Thermal pollution", human activity adding heat to the environment, is completely due to energy use. Radioactivity, once attributable mainly to weapons testing and medical procedures as well as to natural sources, increasingly comes from energy use. Automobiles burning gasoline are the prime source of air pollution. Now the exploitation of energy resources, together with processing and transport, have become an additional environmental concern.

Energy projects have certain characteristics that make environmental planning extra difficult (Wilbanks and Calzonetti). Numerous alternatives to a proposed facility often exist, in terms of both type and location. A given energy supply system – coal, hydroelectric, petroleum, nuclear – typically is fragmented institutionally from extraction and processing to distribution, sale and regulation. Many of the key issues centre on the characteristics and capabilities of technologies. Proposals are often highly technical, aggravating encounters between technical-fix proponents and skeptical opponents. Energy supply decisions are also characterized by great uncertainty – dubious demand forecasts, sharply differing estimates of supply, promises of unproven technology, shifting costs often outside local control, ambiguous and changeable regulatory requirements, and a volatile political and public-opinion climate. Creating further pressure on planners and decision-makers is the urgent need to act and the high risk of making large mistakes, sometimes with irretrievable consequences.

Acknowledgements 4.7

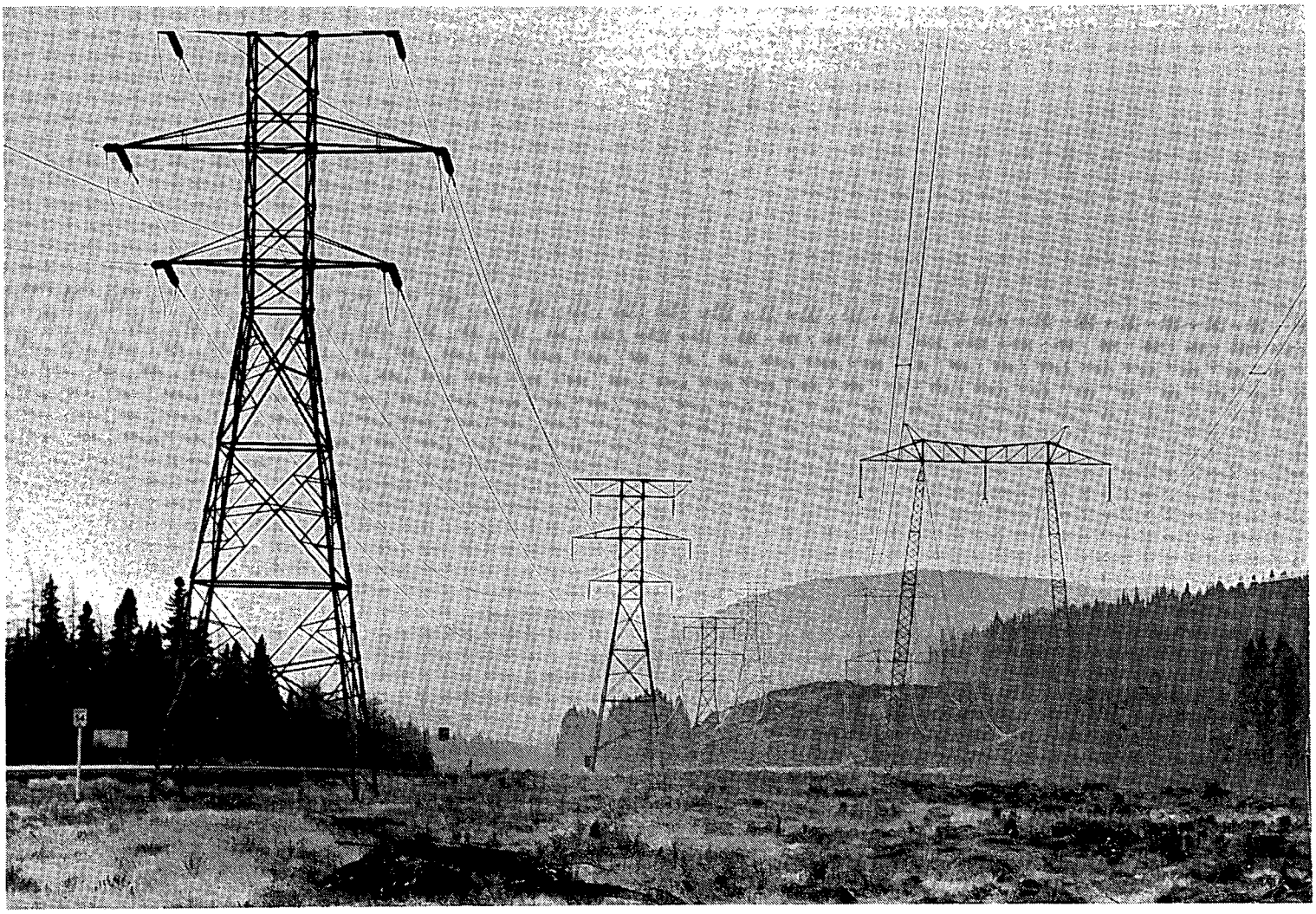
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The main categories of energy projects in Canada are coal, petroleum, nuclear and hydroelectric. While bringing obvious benefits, each creates environmental concerns especially at a time when economic conditions favour the loosening of environmental controls.

Coal. Canadian coal systems are based on surface mining, mainly in the western provinces, and underground mining, predominant in Altantic Canada but becoming more common in the West. Coal, much of it imported, presently accounts for approximately 10% of the nation's energy supply but this has been projected to increase significantly as electricity becomes the backbone of the economy. Electric utilities and steel mills are the principal users. In both production and use, coal development can have substantial environmental impacts, among them:

Land surface degradation. In strip and contour mining, topsoil is lost, often disappearing to the bottom of dug-out strips. Erosion and siltation of nearby streams can also be significant problems. Reclamation, through grading and seeding, is not always successful.



Regeneration of vegetation may be slow, perhaps even impossible if the overburden, once in such close proximity to the coal, has become too acidic to support plant growth.

Stream contamination. Pyrite (FeS_2) entering the water that passes through a coal mine creates a dilute acid. Contamination of local drainage systems can result from subsequent leakage of the acid from the mine, mine tailings and waste dumps. This problem is more troublesome in the Atlantic provinces where the coal has a higher sulfur content. Coal production and processing plants may also generate contaminated process waters which further threaten local water quality.

Air pollution. Depending on the chemical properties of its fuel, a coalfired power plant can emit large quantities of air pollutants: sulfur dioxides, nitrogen oxides, carbon monoxide and particulates. While particulate emissions from boiler stacks can be reduced by electrostatic precipitators, there is no effective way of removing sulfur dioxide and nitrogen gases. Disposal of the solid waste emanating from the scrubber comprises a further environmental problem. Waste dumps, stockpiles at shipping docks or at industrial sites, and the cross-country transport of coal in open-top railway cars are all further sources of airborne pollutants.

Increased use of coal, replacing depleted supplies of oil and natural gas, raises substantial environmental concerns, on two fronts. The first is more air pollution, not just in immediate proximity to the pollutor but extending over large distances. A substantial proportion of the Canadian population lives downwind from the huge urban-industrial complex of north-central United States (see Figure 2.16 in 2.2 Climate and Human Settlement) where massive shifts to coal-burning plants, possibly using high-sulfur fuel, is contemplated. The second concern is the higher carbon dioxide levels that considerably increased burning of coal could create (see 2.2 Climate) with potentially dire consequences for global climate and climate-dependent human activities such as agriculture.

Petroleum. Exploration, extraction, well-head or mine-face processing, transport of raw materials, refining, transport of finished products (pipelines are covered in 4.5 Transportation) and their use, present a number of environmental problems from local to global scales.

Land surface disturbance. The significance of this problem depends on the area in which exploration and production are being carried out. Potential environmental impacts in permafrost areas have been well publicized: long-term scarring of Arctic landscapes; disturbance of vulnerable northern ecosystems by interference with breeding or migration; loss of vegetation and habitats; changes in watercourses; and the warming of tundra soils and melting of ice which could lead to accelerated erosion of topsoil as well as sagging of pipeline foundations. In boreal forest areas clearing for seismic lines can have a severe effect. According to Energy, Mines and Resources Canada, the Alberta petroleum industry cut more forest in 1971 than the forest industries did. In the exploitation of tar sands in western Canada, hundreds of square kilometres of forested land will be dug up and rearranged.

Water pollution. The most pervasive impact of petroleum development is the heavy pollution of water through blow-outs, leaks and spills. Over two million tons of heavy petroleum products reach the ocean each year from normal ocean shipping operations, offshore drilling and oil production, accidental spills, port and industrial activities, and oil-polluted rivers. Water pollution is a serious liability in northern Canada because it is difficult to prevent blow-outs in permafrost areas and because Arctic ecosystems are very sensitive. Another water pollution hazard associated with oil extraction is the considerable amounts of brine produced; ineffective disposal can lead to contamination of ground and surface water.

Solid wastes. Disposal of solid wastes is another difficult-to-solve problem (see 4.3 Solid and Hazardous Wastes). The magnitude and dispersed nature of petroleum exploration and production complicate cleanup operations. For example, it is estimated that for each barrel of oil recovered in the tar sands, three to five tons of material will have to be dug up, processed and disposed of.

Air pollution. Sources of air pollution in petroleum development include burning unusable oil in waste pits (a practice common to small operations where reinjecting the oil into underground reservoirs is not economically feasible), refining processes and power generation. The mix and quantity of pollutants will vary with the type of oil but the

main pollutants are nitrogen oxides, sulfur oxides and hydrocarbons.

Natural gas is by far the least environmentally damaging of the fossil fuel alternatives (if we exclude the liquifying of natural gas, which carries high environmental risk). Natural gas extraction is similar in many ways to the process for oil (often both fuels are taken from the same well) so that the environmental impacts related to oil production are applicable here. After processing, the gas is transported under high pressure in pipelines with minimal risk and land disruption (provided that restoration of disturbed lands is carefully done). Combustion of the gas causes only minor amounts of air pollution from carbon monoxide and nitrogen oxides although it may present water quality problems as a result of thermal discharges.

Nuclear. The nuclear fuel cycle, compared with fossil fuel systems, causes less land disruption, air pollution and water pollution (except for thermal effects, which can be considerable). But nuclear power has a unique characteristic that sets it apart from other energy sources and creates unusual environmental planning and political problems: it emits radioactivity and creates radioactively contaminated wastes, both high and low level ("level" measures penetrating power of radiation, not its toxicity). Radioactivity is of concern because biologically it can be highly toxic, accumulates in food chains, has the potential for causing damage on a large scale and long into the future, and carries unknown genetic risks (see 2.2 Radiation).

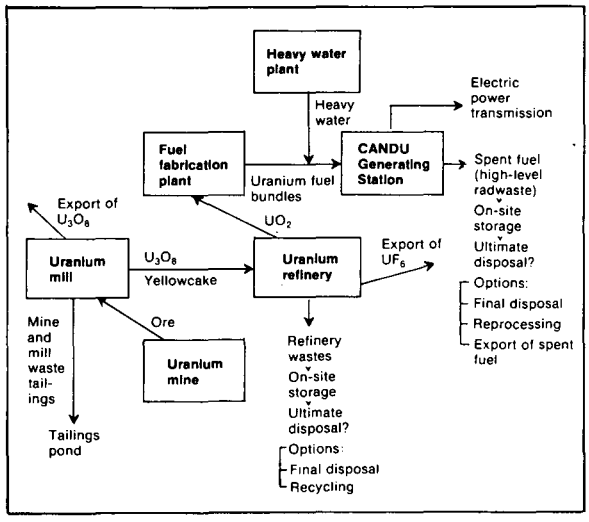


Figure 4.10 The CANDU Fuel Cycle

The environmental hazards posed by nuclear energy involve all aspects of the nuclear fuel cycle: mining of uranium, milling and refining the ore, generating power and disposing of wastes.

Extraction. Two main hazards are associated with surface and underground uranium mining operations. The first is drainage or leaching of radioactive material from the mine into nearby streams. Usually surface and groundwaters in areas of uranium deposits have a locally high "background" of radioactivity; this natural condition could become a serious problem if there is uncontrolled leaching from tailing areas or improper on-site water management. The second hazard is exposure of workers to radon emissions. Lung cancer rates among uranium mine workers exceed the rate for the total male population.

Milling separates the uranium ore from excess rock and other material and concentrates the ore to produce "yellowcake". In the process some radiation is released to the air and a small amount of radioactive liquid and solid waste is produced. Waste materials from both mining and milling, if carelessly discarded, can be carried into water supplies or become hazardous to nearby populations. Radioactively contaminated wastes have been used as fill material on land for urban development, with disastrous consequences.

Refining. Air pollution can become a problem when the ore is further refined to uranium hexafluoride (for export to countries using UF_6 in light-water reactors). This now occurs at only five locations in the world, one of them the Eldorado Nuclear Ltd plant in Port Hope, Ontario. Two additional plants, one in Ontario and another at Warman near Saskatoon, are proposed. Special measures are required to contain the chemically active fluoride and to reduce fluoride emissions that can be harmful to plants and livestock.

Generating power. Nuclear power plants are presently confined to Ontario, Quebec and New Brunswick (see the map, Figure 2.13 in 2.2 Radiation). The Canadian nuclear power program relies on the CANDU heavy-water moderated reactor system. Use of heavy water enables reactors to be fueled with natural material rather than the enriched uranium required by the more common light-water reactor, thereby avoiding the substantial hazards of fuel reprocessing. What will happen when Canada's natural uranium supplies are depleted, however, remains in doubt

(reprocessing of spent fuels or use of the "breeder" reactor bring high environmental risks). During operation, refueling and maintenance of nuclear reactors, environmental problems may arise. Radioactive and other toxic gases together with radioactive liquid may be discharged although to date CANDU reactors have had few problems in this regard; they emit very small amounts of radioactivity, no more than 5% of natural levels. The question of nuclear accidents remains speculative and contentious. Although their probability may be exceedingly low (it is arguable whether probability can even be calculated since no major accidents have yet occurred), the associated risk is very high.

Waste storage and disposal. The principal problem associated with nuclear power is that no proven method exists for safe permanent long-term disposal of reactor wastes. Such wastes are being stored for subsequent transfer to a permanent facility in Canada, whose location is yet to be determined. Shallow-land burial of low-level wastes has been suggested but experience elsewhere, especially in the United States, raises serious concern over possible health and environmental consequences (National Research Council). A further problem of waste disposal involves the shutdown or "decommissioning" of nuclear facilities which, given the long half-lives of some of the nuclides, require perpetual care and may remove permanently the affected areas from human occupation and use.

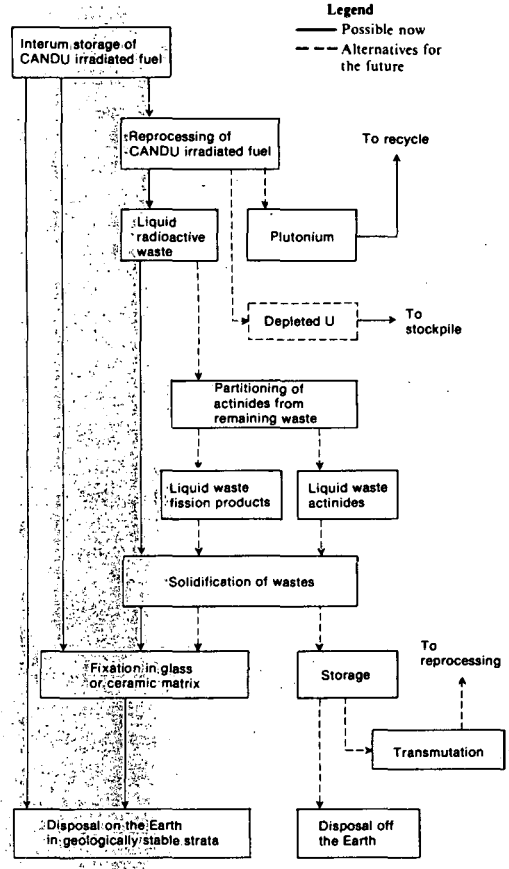


Figure 4.11 Management of Irradiated Fuel

Source: Ontario Hydro, *The Management of Irradiated Fuel in Ontario. Volume 1, A Review* (Toronto: Ontario Hydro, 1977). Cited in: Robert J. Uffen, "Let's go slowly on a nuclear power program until we've solved waste problems" *Science Forum* 59, Vol. 10, No. 5, Oct. 1977.

Hydroelectric. Unlike other energy systems, hydroelectric power does not directly introduce pollutants into the environment. Its adverse impacts result from alterations to the environment, primarily at dam and reservoir sites.

Ecological and cultural disruption. Damming of a river has both long and short-term ecological and cultural effects, many of which are irreversible and difficult to predict. Reservoirs have flooded valuable arable land as well as the highest-capability moose, elk and deer winter range (British Columbia offers examples). People and nonhuman life have been dislocated as a result. If the reservoir floods large areas of forested land, the submerged vegetation may reduce the oxygen content and lower the productivity of the aquatic ecosystem for some time. The dam itself and subsequent changes in water temperature and chemistry are likely to interfere with fish migration and spawning. Upstream migration can be assisted somewhat by fish ladders but downstream migration presents a more serious problem since the fish have to go through the turbines where they may be killed by machinery or changes in pressure. Perhaps the most drastic changes to aquatic life are the variations in flow rates caused by the installation. Some hydroelectric facilities are used as peaking plants, i.e. they are kept in reserve and drawn on when demand is high. Water levels fluctuate greatly, causing erosion and possibly damaging or disrupting shallow water and shoreline habitat and spawning areas.

Scenic degradation. The conditions necessary for a dam site often coincide with the conditions creating a "scenic resource". Dams are

usually built in narrow canyons or gorges with swift, tumultuous rivers – also perceived as most scenic. Sometimes wild rivers are lost and with them go ever-rarer wilderness amenities and recreational potential.

Electric power transmission. Recently, the possible deleterious environmental effects of proposed and existing high-voltage alternating current electric power transmission lines have become contentious public and political issues (Miller and Kaufman).

Effects of location, construction and maintenance. Included here are the occupation of land (often forested or agricultural), the clearing of land within the right-of-way, soil compaction and other construction damage, maintenance of the right-of-way (which may involve use of herbicides), clearing and maintaining access roads, changes in drainage patterns, interference with agriculture due to tower structures, disruption of other patterns of human activity, and changes to habitats.

Visual impacts. Towers and transmission lines are capable of creating major intrusions into the visual landscapes they affect (see 3.5 Scenic Areas) with subsequent loss of aesthetic quality.

Safety hazards. These include the danger of electric shock from transformer stations and power lines (the "flashover" effect, or breakdown of air between the line and a conducting object, possibly leading to lethal current flow).

Corona effects. This refers to the breakdown of air as an insulator near the line when the field at the conductor surface exceeds the dielectric. Unlike flashover, the breakdown is only in the near vicinity of the line and does not provide a pathway for current flow to another conductor. Corona occurs mainly in rainy or foggy weather. Its most obvious effects are audible noise and TV or radio interference. A further corona effect is the generation of chemical oxidants, mainly ozone.

Electric and magnetic effects. Of concern beyond the immediate vicinity of the conductors, possible direct biological effects on human and nonhuman life (birds and fish are particularly sensitive to even weak electric and magnetic fields), induced shock, effects on cardiac pacemakers and spark discharges. Considerable controversy surrounds this question (compare Miller and Kaufman with Young). Generally, the scientific evidence does not support the contention that electric and magnetic fields associated with current levels of electric power transmission produce significant adverse effects; but that has not substantially diminished the concern.

Major energy projects aimed at delivering an array of benefits – positive contributions to the local/regional/national economy, improved energy supply, increased employment, reduction in regional disparity, and so on – may also bring environmental social and economic costs. And, while benefits are often widespread and longer-term, the accompanying costs or negative social/community impacts are local and immediate. Severity of these impacts depends on a number of factors among them the nature of the project, how quickly it is introduced, how much lead time is available to prepare for it, size of the population affected, level of local employment, capacity and condition of local services and facilities, and planning capability. Rate of growth induced by the energy project appears to be significant in predicting its impacts on land use, housing, community facilities and services, municipal fiscal position and resident's lifestyle.

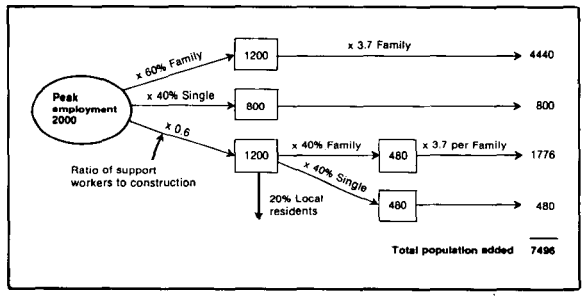


Figure 4.12 Employment and Population Added by Construction of a 2250 MW Coal-fired Electric Generating Plant

Source: U.S. Dept. of Housing and Urban Development, Office of Community Planning and Development, *Rapid Growth from Energy Projects: Ideas for State and Local Action, A Program Guide* (Washington, D.C.: HUD, 1976).

Coping with "boomtown development" and managing the consequent growth is a formidable problem for impacted communities (see National Association of Counties and U.S. Dept. of Housing and Urban Development). Helping them respond effectively ought to be considered a "cost" of energy projects that deserves to be internalized by their proponents and shared by those who will benefit.

Case Study 72
British Columbia's
Northeast Coal Study
Submitted by Ray Crook,
Environment and Land Use Committee Secretariat

In 1976 the Cabinet's Coal Committee initiated a major investigation into the feasibility of large-scale coal exploitation in northeastern B.C. Various coal-mining operations are being promoted by the private-sector; for its part the Province is considering major capital investments to provide trunk highway and railway access to the Northeast Coal Block and it is developing a new resource town. The Ministry of Economic Development, designated the lead agency, established five interagency sub-committees to conduct necessary investigations: Transportation; Townsite/Community Development; Manpower; Coal Resources; and Environment and Land Use.

The Environment and Land Use Sub-committee is chaired by the Secretariat of another committee of Cabinet, the Environment and Land Use Committee. The E.L.U.C. Secretariat has co-opted representatives from various provincial and federal agencies for the sub-committee including the Resource Analysis Branch, Water Investigations Branch, B.C. Forest Service, Fish and Wildlife Branch, Heritage Conservation Branch, Land Management Branch, Mines Reclamation Group, Canadian Wildlife Service and Inland Waters Directorate. The sub-committee, drawing on a special $2.7 million warrant, has also hired numerous contract staff in various resource fields to supplement regular government personnel for the purpose of carrying out the sub-committee's environmental program.

Three primary functions have occupied the sub-committee. The first has been to gather baseline environmental data (usually at 1:50 000) over an area exceeding 50 000 km^2. Inventory sectors include climate, terrain soils, vegetation, water quality, air quality, hydrology, fisheries, big game, aquatic migratory birds, outdoor recreation, aesthetics and heritage resources. Second, the sub-committee has assessed the environmental impacts of major publicly funded projects (a trunk highway, a railway, a resource town) required as infra-structural support for the coal mines. The sub-committee has handled these environmental assessments internally, working closely with the design engineers from other sub-committees. Although there was little public involvement, the results were published in the sub-committee's report, *Northeast Coal Study – Preliminary Environmental Report on Proposed Transportation Links and Townsites,* May 1977 (see Case Study 68 in 4.5 Transportation). The third (unofficial) function of the sub-committee has been to provide a regional environmental perspective in the Province's evaluation of a wide range of other developments, proposed for the Northeast Coal Block, for which formal provincial EIA guidelines are applicable. These include coal-related projects (nine open pit coal mines, two underground mines, coal washing plants, and extensive spur resource road and spur rail networks) and others (a hydro-electric power project and a natural gas pipeline). Coal-related developments are subject to E.L.U.C. *Guidelines for Coal Development while E.L.U.C. Guidelines for Linear Development* apply to the gas pipeline (see 5.7 Regulation and Review). The hydro prject must conform to guidelines agreed between E.L.U.C. and the B.C. Hydro and Power Authority.

The sub-committee's baseline data have provided a regional framework within which provincial reviewers can evaluate various site-specific projects. Moreover, the sub-committee's technical staff has been heavily involved in reviews because of its exceptional expertise in the Northeast Coal Block.

Refer to:
Biophysical Soil Resources and Land Evaluation of the Northeast Coal Study Area. 1976-1977, March 1978. 68 pp. Free. Annotated in 2.4 Soil/Soil Capability.

Visual Resources of the Northeast Coal Study Area, 1976-1977. December 1977. 104 pp. + app. Free. Annotated in 3.5 Scenic Areas.

Outdoor Recreation Resources of the Northeast Coal Study Area, 1976-1977. December 1977. 71 pp. + app. Free. Annotated in 4.6 Recreation.

Vegetation Resources of the Northeast Coal Study Area, 1976-1977. March 1978. 45 pp. Free. Annotated in 2.5 Forests.

Wildlife Resources of the Northeast Coal Study Area, 1976-1977. 58 pp. Free. Annotated in 2.6 Wildlife and Fish.

Heritage Resources of the Northeast Coal Study Area, 1976.

Northeast Coal Study . . . Preliminary Environmental Report, March 1977. 141 pp. + app. Victoria: Queen's Printer, $8.00.

Northeast Coal Study, Preliminary Feasibility Report on Townsite/Community Development and Conceptual Plan, Tumbler Ridge, Northeast Sector, B.C. March 1978. 168 pp. See Case Study 59 in 4.2 Urbanisation, and Case Study 86 in 5.4 Plans.

Guidelines for Coal Development. March 1976. 33 pp. Free. Annotated in 5.7 Regulation and Review.

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Case Study 73
Ontario Hydro's Social/ Community Studies Program
Submitted by John Walker, Ontario Hydro

One of Ontario Hydro's concerns is the impact its generating facilities have on communities near the station sites. Community impact is taken to mean any change imposed on a community's social or economic situation as it presently exists, as it would otherwise develop or as it was previously planned. In the evaluation of community impacts Ontario Hydro takes account of a range of socio-economic factors: population, employment and economic base, housing and property values, transportation, public works, parks and recreation, educational facilities, health and safety, social services, social aspects, lifestyle and culture, community and regional planning, and municipal administration and finance. Construction and operation of Hydro facilities affect the social and economic structure of neighbouring communities in a variety of ways. The influx of relocated workers and some families results in increased demands on local housing, consumer goods and various services. Other social and economic effects may be caused by greater demands on the local labour supply, Hydro labour relations, local purchases of materials and services by the project, the traffic it generates, and payment of grants-in-lieu of taxes.

Ontario Hydro's policy is that communities should not be required to shoulder the burden of these impacts and a procedure has been developed to determine them. It begins at the initial site selection stage and continues through the construction and commissioning stages to full operation of the facility. Hydro negotiates community impact agreements with municipalities to establish its liability for impact costs during the life of the project and to provide sufficient financial assistance to municipal governments affected. The funds are also used for planning studies and a community monitoring program during the construction and initial operating periods.
Hydro's approach to community impact, through specific studies, has been evolving; social impacts are acknowledged to need further development. Community impact agreements are relatively new. The first was signed in 1977 with the Town of Newcastle concerning the Darlington Nuclear Generating Station, the second was recently negotiated for the Atikokan Station, and the third is in the final negotiating stages for the Wesleyville Station. The municipalities concerned seem satisfied with the impact assessment process but it remains to be seen how successful the agreements will be. Both would appear to have application in other situations where major projects are being considered.

Refer to:
Ontario Hydro, *Socio-Economic Factors: Submission to the Royal Commission on Electric Power Planning with Respect to the Public Information Hearings*, revised February 1977, 20 pp., free from Ontario Hydro. An example of a recent community impact study is: Proctor and Redfern Ltd., *Marmion Lake Generating Station, Community Impact Study.* Phase I Report, January 1976, 60 pp. + app.

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Information Resources

See also:
2.2 Radiation
2.7 Energy
5.5 Environmental Impact Assessment

Alexander, Tom, "A Promising Try at Environmental Detente for Coal", *Fortune*, 13 February 1978, pp. 94-102.

Describes the National Coal Policy Project which brought together 30 environmentalists and 30 representatives of coal-mining and coal-using industries in an attempt, apparently successful, to work out the environmental problems accompanying the mining, transport, burning and conservation of coal. See Case Study 62 in 4.4 Resource Development.

Aikin, A.M., Harrison, J.M. and Hare, F.K. *The Management of Canada's Nuclear Waste.* Dept. of Energy, Mines and Resources (Ottawa K1A 0E4), August 1977. Paperback, 63 pp. Free.

Annotated in 2.2 Radiation. See also: C.R. Phillips and H.L. Pai, "Environmental Impact of Radioactive Waste Management in the Nuclear Industry", *Water, Air and Soil Pollution*, Vol. 8, No. 2, June 1977 (the authors are professors at the University of Toronto); Ontario Hydro, below; H.Y. Tammemagi, *Geological Disposal of Radioactive Wastes – The Canadian Development Program*, Atomic Energy of Canada Ltd. (275 Slater St., Ottawa K1A 0S4), May 1976; Peter J. Dyn, *Managing Nuclear Wastes*, AECL Special Publication, 1975; Lydia Dotto, "Nuclear Wastes: The Debate is Heating Up", *Globe and Mail*, 3 January 1978, p. 4, and Jeff Carruthers, "Ontario, Ottawa agree on plan for storing of spent nuclear fuel", *Globe and Mail*, 6 June 1978, which describes the two government's agreement for phase one of a 25-year "waste management development program", finding an acceptable disposal site.

Batelle – Pacific Northwest Laboratories. *A Technique for Environmental Decision Making Using Quantified Social and Aesthetic Values.* Washington, DC: U.S. Atomic Energy Commission, 1974. 109 pp. + app. Available from National Technical Information Service (5285 Port Royal Rd., Springfield VA 22161), BNWL-1787, $9.50.

Reports the results of the first of four phases of a study of social/economic/environmental tradeoffs in the analysis of nuclear plant siting options, and presents a method for combining social and techno-economic values. The technique requires that community judgements be measured on the same plant design criteria that are independently quantified by experts on a technical basis; social values are used as a weighing factor for techno-economic values. Eight sets of criteria, determined to be significant in analyzing nuclear plant options, were examined: economics, water quality, air quality, plant and animal life, cultural and recreational, health and safety, aesthetics and land use. The last two were examined more closely in an attempt to derive methods for quantifying these effects. Such a method was developed for aesthetic impacts, and occupied 40% of the text. Land use, it was concluded, could be eliminated as a selection criterion by deriving suitability and compatability from the other seven factors.

Bay of Fundy Tidal Power, Environmental Assessment Panel. *Draft Guidelines.* Environment Canada, Federal Environmental Assessment Review Office (Ottawa K1A 0H3), April 1978. French and English. 43 pp.

Guidelines for preparation of an Environmental Impact Statement for the Fundy Tidal Power Project. See also: S.L. Hold et al., *Environmental Considerations of a Fundy Tidal Power Project*, Acadia University Institute (Acadia University, Wolfville, N.S.), Publication No. 28, 1977, pp. 71-81.

Beall, S.E. et al. *Assessment of the Environmental Impact of Alternative Energy Sources.* 1974. 134 pp. National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), ONRL-5024/PSP, $6.00.

Berkshire County Regional Planning Commission. *Evaluation of Power Facilities: A Reviewer's Handbook.* Berkshire County, Mass.: The Commission, 1974. 378 pp. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), PB-239 221, $10.25. Covers environmental, physical, social, economic and fiscal impacts in detail.

Clark, B.D. et al. *Assessment of Major Industrial Applications, A Manual. Scottish Development Dept. (New St. Andrews House, Edinburgh, Scotland), 1976. 170 pp. £2.*

The impetus for the study resulting in this manual was North Sea oil development and subsequent problems in Scotland. Annotated further in 5.5 Environmental Impact Assessment.

"Coastal Energy Impact Program, Project Assessments and Environmental Impact Statements: Environmental Guidelines for Preparation", *Federal Register*, Vol. 42, No. 171, 2 September 1977, pp. 44 400-44 404.

Annotated in 3.4 Marine Coastal Zone.

Coleman, B. *A Bibliography of the Social Effects of Nuclear Power (1945-1973).* B.C. Hydro and Power Authority, Policy and Long-Term Planning Unit (4 400 W. Saanich, Victoria, B.C.), 1974. 188 pp.

Conseil consultatif de l'environnement. *Implications environnementales et sécuritaires de l'usine d'eau lourde La Prade.* Le Conseil consultatif de l'environnement (1020, Saint-Augustin, Québec, Qué. G1R 4Z4), décembre 1977.

The Quebec government agency's study of the environmental and safety implications of the La Prade heavy water plant.

Eichholz, G.G. *Environmental Aspects of Nuclear Power.* Ann Arbor, MN: Ann Arbor Science Publishers, 1976. Hardcover, 683 pp.

Describes the state-of-the-art in nuclear power plant design and operation, power plant siting and environmental dispersion of radioactive effluent. Each chapter includes a comprehensive list of references.

Flowers, Sir Brian. *Royal Commission on Environmental Pollution, Sixth Report. Nuclear Power and the Environment.* London, England: Her Majesty's Stationery Office, September 1976.

The Flowers report provides a clear and accurate review, in layman's language, of scientific principles, major issues, alternative energy strategies, control arrangements, safety of nuclear power, and problems relating to reactor choice. It discusses security and safeguarding of fuels, fuel reprocessing and radioactive waste management. Two of its 50 recommendations are of particular interest:

> *There should be no commitment to a large programme of nuclear fission power until it has been demonstrated beyond reasonable doubt that a method exists to ensure the safe containment of long-lived highly radioactive waste for the indefinite future.*
>
> *The dangers of the creation of plutonium in large quantities in conditions of increasing world unrest are genuine and serious. We should not rely for energy supply on a process that produces such a hazardous substance as plutonium unless there is no reasonable alternative.*

Fowler, John M. *Energy and the Environment.* Toronto: McGraw-Hill, 1975. Paperback, 496 pp. $9.50.

A readable comprehensive discussion of the complex energy and environment issues and policy choices many countries face today. The book is supplemented by five appendices which cover more deeply the nature of energy and energy development.

Futures Group. *A Technology Assessment of Geothermal Energy Resources Development.* 1975. 500 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), NSF-RA-X-75-011, $6.00 + 25% outside U.S.A.

Suggests the potential energy futures for geothermal energy in the U.S. and makes evaluations and recommendations. See also: U.S. Energy Research and Development Administration, *Geothermal Resources: A Bibliography*, TID 3354-R1, 1976, 300 pp, available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), $16.25. And, more specifically on environmental impacts: U.S. Dept. of the Interior, Fish and Wildlife Service, *Geothermal Handbook* (Washington, DC: ERDA, 1976), 194 pp.; contact U.S. Dept. of Energy (Washington, DC 20545).

Galibois, Gaston. *La traversée des Laurentides Montréalaises par les lignes de transport de la Baie James.* Association of Consulting Engineers of Canada (130 Albert St., Suite 616, Ottawa K1P 5G4), 1976. 30 pp.

Paper presented to the Association's "Environment II" conference in Montreal in September 1976 by the Director of Environment for Hydro Quebec, on the environmental aspects of a high-voltage overhead transmission line.

Gartner Lee Associates Ltd. *Hydrogeologic Implications of Power Line Right-of-Way Construction and Maintenance Practices: A Review for Ontario Hydro.* Ontario Hydro, Route and Site Selection Division (700 University Ave., Toronto M5G 1X6), May 1978. 15 pp.

Graf-Webster, E. et al. *Resource and Land Investigations (RALI) Program: Methodologies for Environmental Analysis. Volume III: Power Plant Siting.* Mitre Corporation (1820 Dolley Madison Blvd., McLean, VA 22101), 1974. 460 pp.

Commissioned by the U.S. Geological Survey (12201 Sunrise Valley Drive, Reston, VA 22092), this extensive report reviews methods used to select environmentally suitable and technically feasible sites for the location of steam electric power plants, primarily fossil-fueled and nuclear. Included is a 311 page annotated bibliography on power-plant siting methods, environmental/economic/engineering/technical/institutional factors affecting site selection, and models and case studies of actual sitings. Volume I addresses methods for performing environmental assessment in general while Volume II treats methods for the selection of environmentally suitable corridors for utility lines (see Holberger).

The Guardian. *Windscale: A Summary of the Evidence and the Argument.* Guardian Newspapers Ltd. (119 Farrington Road, London, England ECIR 3ER), 1978. Paperback. 107 pp.

In October 1976, a radioactive leak occurred at British Nuclear Fuel Limited's nuclear reprocessing facility at Windscale on England's northwest coast. Eight months later the government appointed Mr. Justice Parker to conduct a public inquiry, including public hearings, and to make recommendations on whether proposed expansion of the Windscale facility should proceed. Principal concerns were safety, environmental and health effects and community impacts. This book documents newspaper coverage of the inquiry which concluded that the project environmentally is the best way to handle nuclear waste.

Hill, Philip G. *Power Generation: Resources, Hazards, Technology and Costs.* Cambridge, MA: MIT Press, 1977. Hardcover, 480 pp. $19.95.

Holberger, R. et al. *Resource and Land Investigations (RALI) Program: Considerations in Evaluating Utility Line Proposals.* Mitre Corporation (1820 Dolley Madison Blvd., McLean, VA 22101), 1975. Availability uncertain.

Prepared for the U.S. Department of the Interior, Bureau of Land Management (Washington, DC 20240), this extensive document covers a wide range of considerations in evaluating the location of a proposed utility line and its probable environmental impacts ("utility line" includes lines that transmit electric power both overhead and underground, as well as pipelines through which energy commodities of all types flow). The principal environmental factors and technical variables are analyzed in depth; legal requirements are then summarized, multiple use of corridors is addressed, and case studies illustrating methods are presented. Part of a 3-volume series (see Graf-Webster).

Karam, R.A. and Morgan, Karl Z. (eds.). *Environmental Impact of Nuclear Power Plants.* New York: Pergamon Press, 1976. Hardcover, 546 pp. $38.50.

Proceedings of a conference at Georgia Insitute of Technology, November 1974, organized under six headings: plant site selection; ecology; radioactive waste and thermal pollution; standards and guidelines in the preparation of environmental impact statements (including a paper on social impacts); cost-benefit analysis; and impact studies of various power sources.

Lehmann, E.J. *Thermal Pollution. Part I: Control Techniques and General Studies. Part II: Biological Effects. Part III: Hydrology and Hydrodynamics.* April 1977. Available from National Technical Information Service (5285 Port Royal Road, Springfield, VA 22151), PS-77/0184/0CCS, PS-77/0185/7CCS and PS-77/0186/5CCS. $25.00 per Part.

MacLaren Atlantic Ltd. et al. *Comparison of Environmental Factors Relating to Alternative Sites for a Nuclear Generating Station.* New Brunswick Dept. of the Environment (P.O. Box 6000, Fredericton, N.B. E3B 5H1), May 1974. 22 pp.

Relates to the Point Lepreau nuclear power plant (two 600 MW CANDU unit) now under construction. See also the report of the Federal Environmental Assessment Panel, May 1975, available from Environment Canada, Federal Environmental Assessment Review Office (Ottawa K1A 0H3).

MacLaren, James F. Ltd. *Environmental Assessment of the Proposed Elliot Lake Uranium Mines Expansion.* MacLaren (435 McNicoll Ave., Willowdale, Ont. M2H 2R8), 1978. 4 volumes.

Prepared for the mining companies as the technical basis for extended public hearings. See especially *Vol. 3, Community Assessment*, and *Vol. 4, Environmental Assessment.* Contact the Environmental Assessment Board (1 St. Clair Ave. W., Toronto, M4V 1J7) for information on the hearings.

McLaren, James F. Ltd. *Wesleyville Generating Station: Community Impacts.* Ontario Hydro (700 University Ave., Toronto M5G 1X6), April 1977.

Ontario Hydro is constructing a large oil-fired power generating facility at Wesleyville on the north shore of Lake Ontario east of Oshawa. This report evaluates various impacts of the construction and operation of the facility in terms of population, employment and economics, water supply and sewerage systems, housing, "community services" (education, health, solid wste management, recreation, etc.) and municipal finance.

Miller, Morton W. and Kaufman, Gary E., "High Voltage Overhead", *Science Forum*, Jan/Feb 1978, pp. 6-15, 32-36.

After overviewing the possible impacts of transmission lines on the environment, this article concentrates on effects associated with electric and magnetic fields beyond the immediate vicinity of the conductors. From a review of the extensive research on this subject the authors conclude: "Neither animal and plant experimentation nor clinical studies nor 25 years experience with operating EHV transmission lines have to-date provided convincing evidence for a harmful effect of exposure to electric and magnetic fields associated with transmission lines, in spite of numerous attempts to find such effects. Likewise, on a biophysical basis one would have no reason to expect there to be effects".

Myhra, David, "Energy Development", *Practicing Planner* (American Institute of Planners), Sept. 1970, pp. 12-19.

Describes two examples of communities dealing with social and economic impacts of energy projects: Colstrip, Montana, where the Montana Power Company is building a new community associated with coal mining and electric power generators; and Skagit County, Washington, where the Puget Sound Power and Light Company has negotiated a unique "construction impact payments agreement" with the local government.

National Association of Counties. *Case Studies on Energy Impacts. No. 2: Controlling Boomtown Development, Sweetwater and Vinta Counties, Wyoming.* The Association (1735 New York Ave., Washington, DC 20006), Jan. 1976. 43 pp.

One of a series of case studies on counties that have been or will be affected by energy projects. Sweetwater County is a coal-rich area which saw its population double from 1971 to 1976 as a result of opening of a 2500 MW power plant and associated industrial growth. Neighbouring Vinta County has become a bedroom community for Sweetwater's industrial and mining workers. In both cases preparation for growth was inadequate but valuable experience, documented here, was accumulated. See also: Mary K. Duff and John S. Gilmore, *Boom Town Growth Management*, University of Denver Research Institute (University of Denver, Denver, CO 80210), 1975, 200 pp. + app., $15.00.

Noyes, Robert (ed.). *Offshore and Underground Power Plants.* Noyes Data Corp. (Mill Road and Grand Ave., Park Ridge, NJ 07656), 1977. 309 pp. $4.20.

Explores the potential, technology, costs and environmental considerations of fossil-fuel and nuclear power plants located offshore or underground.

Ontario Hydro. *Generation-Environmental.* Ontario Hydro (700 University Ave., Toronto M5G 1X6), March 1976. 61 pp. *Socio-Economic Factors*, 1976, revised 1977. 20 pp. Free.

Submissions to the Royal Commission on Electric Power Planning (14 Carlton St., 7th Floor, Toronto M5B 1K5). The first report discusses: the development of environmental studies and environmental assessment for Hydro projects; radioactive emissions from nuclear generating stations;

non-radioactive aspects of nuclear fossil and heavy water plants; and (briefly) environmental effects of hydroelectric power development. The second report outlines Hydro's "Community Impact" study approach (see Case Study 73).

Ontario Hydro. *500 kV Transmission Line Right-of-Way, Bradley-Georgetown Environmental Report.* Ontario Hydro (Public Relations Division, 700 University Ave., Toronto M5G 1X6), n.d. (about 1976). Three volumes.

Three-volume report on the environmental effects of a proposed overhead transmission line including examination and comparison of alternatives. A summary volume is available free from Ontario Hydro. Volumes 1 and 2, comprising the complete environmental report, are available at $5.00 per set from the Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), cheque payable to Treasurer of Ontario.

Ontario Hydro. *Living and Working Under Extra-High-Voltage Power Lines.* Ontario Hydro, Community Relations Dept. (700 University Ave., Toronto M5G 1X6), n.d. Foldout.

Introduces Hydro's Demonstration Centre located directly under the 500 kV line at Essa, near Barrie. At the Centre, Hydro duplicates conditions that could be encountered by people working under such lines. Demonstrations are conducted, for groups on request, on such topics as electric fields under EHV lines, effects on farm operations, ways of grounding vehicles, TV and radio reception, etc. Two other booklets available from Hydro are *Extra High Voltage on Agricultural Lands and Working Under Extra High Voltage Transmission Lines.*

Ontario Hydro. *North Channel Environmental Assessment.* Ontario Hydro (700 University Ave., Toronto M5G 1X6), June 1978. 85 pp. + app.

Hydro proposes development of an "energy centre" on the North Channel of Lake Huron between Thessalon and Blind River. The 1 600 ha site is to accommodate future generation (whether coal-fired or nuclear is not yet known) and heavy water facilities with associated transmission lines. The environmental assessment covers the need for an energy centre site and transmission routes, project requirements, public involvement, energy centre site selection, transmission band selection, comparison of alternative site and band systems, and proposals. Appendices include a submission from a local citizens committee (organized by Hydro to contribute to the site selection process, ensure that community interests were fully considered and that people were adequately informed, and to continue as a working group during the design and construction phases), the existing site environment and criteria for site selection.

Ontario Hydro. *Proposal for Atikokan Generating Station.* Ontario Hydro (700 University Ave., Toronto M5G 1X6), May 1977.

This document describes the proposed coal-fired 800 MW generating station in northwestern Ontario. Chapters describe: the need for the project; the site, the proposed facilities, manpower requirements, environmental control systems and contingency plans; regulatory and legal requirements including environmental assessment; the existing environment; environmental effects during construction; environmental effects during operation; alternatives; and the public participation program.

Ontario Hydro. *The Management of Irradiated Fuel in Ontario. Volume I, A Review.* Ontario Hydro (700 University Ave., Toronto M5G 1X6), 1977.

Pennsylvania Power & Light Co. *A Monitoring Study of Community Impacts for the Susquehanna Steam Electric Station.* The Company, Community Affairs (Allentown, PA), June 1976. 66 pp. Free.

The Company decided to set up a procedure which would collect pertinent information on the impacts on the people and communities affected, of the construction and subsequent operation of its 2 100 MW nuclear power plant. Expected social impacts – an influx of construction workers, disruption of community and school systems, heavy use of hospital and other services, severe effect on the local housing market – have not occurred although there were social problems in the initial construction phase. The monitoring study sought to get at the longer-term impacts during plant operation; this report sets up the information gathering and updating process.

Rimberg, David. *Utilization of Waste Heat from Power Plants.* Noyes Data Corporation (Mill Road at Grand Ave., Park Ridge, NJ 07656), 1974. 175 pp. $18.00.

Royal Commission on Electric Power Planning. *A Race Against Time.* Toronto: The Commission, Sept. 1978. 227 pp. Available from the Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $5.00, cheque payable to Treasurer of Ontario. Summary available free from the Royal Commission (14 Carlton St., 7th Floor, Toronto M5B 1K5).

The Porter Commission's interim report on nuclear power. It concludes: electricity demand will probably grow at 4% per year to the year 2000 (historically, it has been over 7%); some expansion of bulk power generation is needed before then; nuclear power has a role to play in that expansion (Ontario now has 3800 MW of installed operating nuclear power, accounting for 27% of total electrical energy generated in the province); the CANDU reactor is reasonably safe; a way will be found to dispose of radwaste safely and in an environmentally, socially and technically acceptable manner; new nuclear stations to the year 2000 will require capital outlays of $25 to 60 billion, which makes capital availability a major constraint on a nuclear future; a flexible mix of options is required to meet Ontario's diverse nees; no more than three additional nuclear stations are needed to the year 2000; and the regulation of nuclear power should be an open public process, including environmental assessment.

Royal Commission on Electric Power Planning. *Our Energy Options.* Toronto: The Commission, 1978. Available from Ontario Government Bookstore (880 Bay St. Toronto M7A 1N8), $2.00, cheque payable to Treasurer of Ontario.

Seven papers examine various aspects of electric power planning: efficient use of energy; environmental and health issues; alternative power generation technologies; nuclear energy; fuels and power generation; bulk transmission; and the socio-economic significance of electric power policy.

Sagan, Leonard A. (ed.). *Human and Ecologic Effects of Nuclear Power Plants.* Springfield, Ill.: Charles C. Thomas, 1974. Hardcover, 536 pp. $34.50.

Intended as a comprehensive introduction to nuclear power for the interested layman and a reference for the technical expert. 14 papers cover: generation and management of radioactivity (reactor design, standards for radioactive emissions, power reactor siting in the United States, control of radioactive wastes in nuclear plant operation, accidental releases, shipment of radioactive materials, fuel reprocessing, high-level waste and breeder reactors); and ecological effects of nuclear generation (effects of radioactive emissions and thermal discharges, human radiation exposure, genetic damage and long-lived isotopes from nuclear power production).

Schiefer, K. and Eedy, W., "Environmental Studies for Wreck Cove", *International Water Power and Dam Construction,* Vol. 30, No. 1, 1978, pp. 31-38.

Refers to the environmental assessment of the Wreck Cove hydroelectric project in northern Cape Breton, Nova Scotia.

Scientists Institute for Public Information. *Nuclear Power, Economics and the Environment.* SIPI (355 Lexington Ave., New York, NY 10017), 1977. $2.00.

Sheridan College of Applied Arts and Technology, Research Centre. *Public Attitudes Concerning a Possible Energy Centre Site Along the North Channel of Lake Huron.* Ontario Hydro, Route and Site Selection Division (700 University Ave., Toronto M5G 1X6), Nov. 1977. 62 pp.

This study measured public attitudes toward the possible development of an "energy centre" (nuclear or coal-fired plant, maybe a heavy water plant). Support for the proposal varied from about three-quarters to less than half of the respondents, a decline over the past two years. Underlying the support are expected economic benefits while concern is based on potential environmental effects. Public support for nuclear power also declined slightly. On the other hand, more people now support controls on household and industrial use of energy.

Stanford Research Institute. *Energy Development: The Environmental Trade-offs. Volumes I-4.* Washington, D.C.: U.S. Environmental Protection Agency, 1975. Available from National Technical Information Service (5285 Port

Royal Rd., Springfield, VA 22161). Vol. 1, $4.00; Vol. 2, $6.00; Vol. 3, $4.50; Vol. 4, $6.00.

Examines the environmental and social impact trade-offs among three options to increase U.S. domestic energy supply – coal, oil and gas. Volume 1 summarizes the other three volumes. Volumes 2 presents the environmental trade-off analysis. Volume 3 investigates the relative environmental impacts of oil spills in ten proposed offshore continental shelf areas. Volume 4 consists of background papers.

Uffen, Robert J., "Let's go slowly on a nuclear power program until we've solved waste problems", *Science Forum*, Vol. 10, No. 5, October 1977, pp. 3-7.

The author, Dean of the Faculty of Applied Science at Queen's University and Vice-Chairman of the board of directors of Ontario Hydro, was chief science advisor to the federal Cabinet. This article reports on his research into disposal of long-lived radioactive wastes from nuclear reactors.

U.K. Department of the Environment. *Nuclear Power and the Environment: The Government's Response to the Sixth Report of the Royal Commission on Environmental Pollution.* London, England: Her Majesty's Stationary Office, May 1977. 45 pp.

The Royal Commission, headed by Sir Brian Flowers, was charged with examining the consequences of nuclear power in Britain. This is the Government's response to the Commission's recommendations.

Union of Concerned Scientists. *The Nuclear Fuel Cycle: A Survey of the Public Health, Environmental and National Security Effects of Nuclear Power.* Revised Edition. Cambridge, MA: MIT Press, 1975. Paperback, 291 pp. $4.95.

University of Guelph, Centre for Resources Development. *Location Hydro.* The Centre (Guelph, Ont. N1G 2W1), n.d., 166 pp.

A report for Ontario Hydro, on how and where to locate overhead transmission lines to minimize environmental impacts. Annotated in 3.5 Scenic Areas.

University of Oklahoma, Science and Public Policy Program. *Energy Alternatives: A Comparative Analysis.* Washington, DC: Council on Environmental Quality, May 1975. 661 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 041-011-00025-4, $7.45 + 25% outside U.S.A.

This report, aimed at contributing to the development of methods for environmental impact assessment of energy alternatives, describes and analyzes in detail eleven "energy resource systems": coal, oil shale, crude oil, natural gas, tar sands, nuclear energy (fission), nuclear energy (fusion), geothermal energy, hydroelectric, organic waste and solar. Subsequent chapters cover electric power generation, energy consumption, procedures for comparing the residuals, energy efficiencies and economic costs of energy alternatives.

U.S. Council on Environmental Quality. *Energy and Environment.* The Council (722 Jackson Place NW, Washington, DC 20036), 1973. 58 pp.

A brief comparative analysis of the environmental effects of four alternative energy systems – coal, oil, gas and nuclear fission. The report also examines the implications of tighter environmental controls and concludes, "Internalizing the costs of environmental control should stimulate use of energy systems that are the least damaging to the environment . . . Not only with the system mix change, but depending on the elasticity of demand, the rate of increase in total energy use may be reduced".

U.S. Dept. of Energy, "Cooling Waters". DOE Film Library (P.O. Box 62, Oak Ridge, Tenn.). Free loan (availability in Canada uncertain).

A 26-minute colour film describing government-sponsored research to assess environmental effects of electric power generation.

U.S. Dept. of Housing and Urban Development, Office of Community Planning and Development. *Rapid Growth from Energy Projects: Ideas for State and Local Action, A Program Guide.* HUD (Washington, DC 20410), 1976. 59 pp. Free.

This useful report deals with how to manage growth when an area is suddenly affected by a major energy project – a new generating station, a mine, an off-shore oil facility, a port, a refinery, etc. It indicates what the community impacts of energy projects are likely to be, shares ideas for action among affected communities based on actual experience drawn from U.S. case studies, and points out sources of information and assistance.

U.S. Energy Research and Development Agency. *Stimulation of Geothermal Energy Sources.* Washington, DC: ERDA, n.d. 52 pp. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), ERDA-37/PSP, $4.50.

U.S. Nuclear Regulatory Commission. *Preparation of Environmental Reports for Nuclear Power Stations.* The Commission (Washington, DC 20555), 1975. 77 pp.

Sets out in detail the standard format and content of such environmental reports.

Warden, Geoff. *Black Pits and Vanishing Hills – Coal Development in British Columbia.* B.C. Wildlife Federation (17633 – 57th Ave., Surrey, B.C. V3S 1G9), 1976.

The overall impacts of coal mining, oriented to the layperson.

Warren, Betty. *The Energy and Environment Bibliography.* Revised Edition. Friends of the Earth Foundation (124 Spear St., San Francisco, CA 94105), 1978. 100 pp. $3.50.

Wilbanks, Thomas J. and Calzonetti, Frank. *Locating Noxious Energy Supply Facilities.* University of Oklahoma, Dept of Geography and Science and Public Policy Program (Norman, Oklahoma), April 1976. 33 pp.

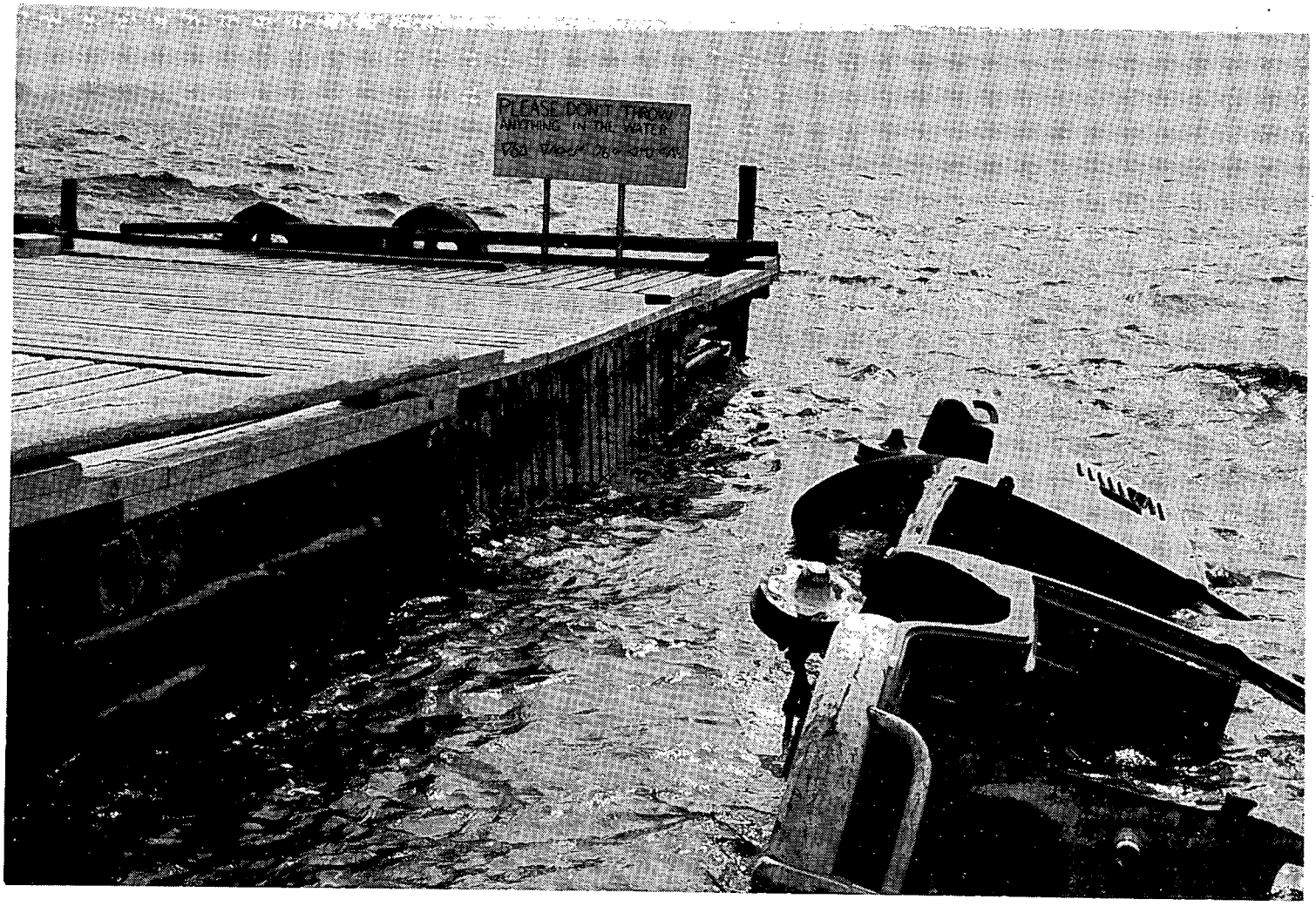
Energy supply facilities are viewed as "noxious" because they may have potentially catastrophic or chronic long-term impacts, compete for scarce resources and disrupt quality of life. Citing the theory and experience of locating such facilities, the authors show how the associated problems basically differ in other ways, then examine means of resolving locational conflicts using reward, legitimacy and, especially, information (rather than coercion, expertise or reference to higher-order needs). See also: Wilbanks and Calzonetti, *Information, Uncertainty and the Location of New Energy Supply Facilities*, April 1976.

Young, Louise B. *Power over People.* London: Oxford University Press, 1973. Paperback, 234 pp. $3.50.

A controversial book (the back cover shows the author standing under a 765-kV power line and holding two fluorescent bulbs that are lighted solely by the intense electric field present). Focuses on the alleged hazards of high-voltage electric power transmission. See also Louise B. Young, "Danger: High Voltage", *Science Forum*, Vol. 20, No. 4, May 1978.

Chapter 5

5. Environmental Planning/Management



5.1 Environmental Planning in a Management Framework

Management implies giving direction and control to human affairs. Planning, as one component of management, is pervasive throughout management processes.

This chapter begins by locating the planning function in a management framework, within and among organizations. The six sections that follow provide an overview of selected sets of planning/management initiatives accompanied by case studies and information sources. The last section discusses public participation and the special role it plays in environmental planning and management.

Though necessary, environmental planning is not a sufficient condition for the optimal enhancement of environmental capacity and quality. Environmental concern must extend *throughout* the management process.

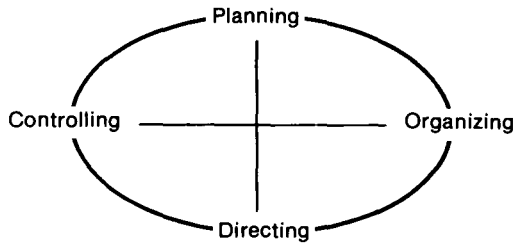


Figure 5.1 The Management Process

The classic view of management divides it into four related functions:

Planning:	formulating objectives to achieve goals in accordance with available resources, and devising and selecting from among alternative courses of action.
Organizing:	grouping activities, establishing authority relationships and providing necessary coordination.
Directing:	providing leadership and guidance, mobilizing and motivating, maintaining communication, and ensuring accountability.
Controlling:	evaluating accomplishments against plans, and correcting performance and plans accordingly.

The planning activity takes place throughout and among organizations. Planning within an organization occurs at three levels (adapted from Anthony):

Strategic level. The top; concern with determining the ends, with goals and policies, and with the availability and use of resources needed to achieve goals. The job of the council, the Cabinet, board of directors, etc.

Administrative level. The middle; concern with devising means, with organizing programs to see that goals are achieved. The job of senior managers.

Operational level. The bottom; concern with effectuating programs, with carrying out spe-

cific tasks effectively (according to the defined objectives) and efficiently (maximum output for given input). The job of supervisors.

The planning function includes (a) the preparation of *strategic* plans, with due recognition of plans of other organizations, as the framework for (b) the formulation of various *tactical* plans to guide specific implementing actions, with both kinds of planning closely related to (c) *control* including monitoring of planned and unplanned outcomes. Policies combine the planning and control functions. A *policy* is a broad guiding decision applied to a class of decisions expected to occur or recur in the future. It is intended to ensure that certain decisions of the organization (a municipal government, for example) adhere as closely as possible to its objectives.

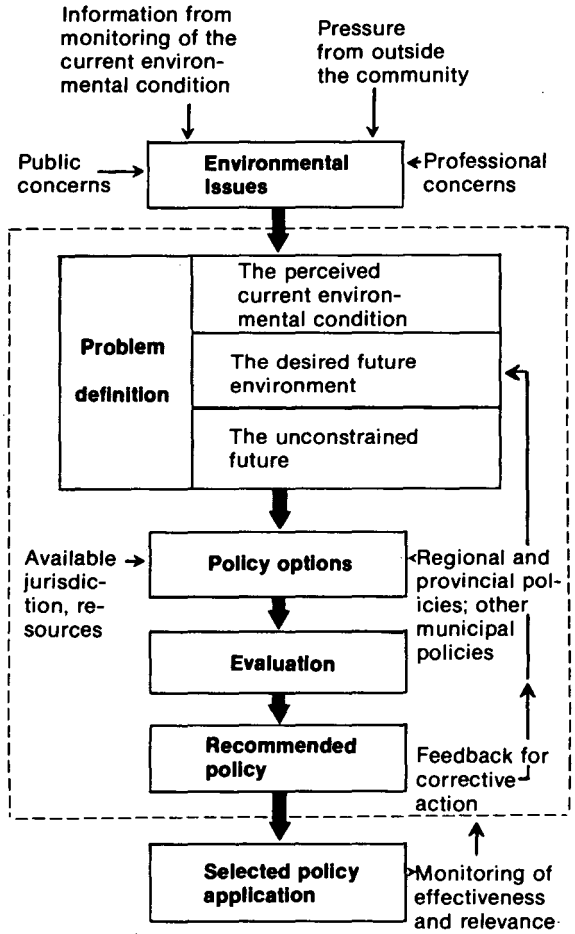


Figure 5.2 A Policy Formulation Process

Source: Reg Lang and Audrey Armour, *Oakville Environmental Report: A Case Study in Environmental Planning* (Toronto: Lang Armour Associates, 1977). Reproduced with permission.

The world moves into the future as a result of decisions, not as a result of plans. Plans are significant only insofar as they affect decisions. Planning may be defined in such a way that it is part of the total decision-making process; but if it is not part of a decision-making process, it is a bag of wind, a piece of paper, and worthless diagrams.
Kenneth Boulding

Attempts to direct public and private actions toward a more favourable environmental outcome have to reflect the *diversity of planning*, horizontally and vertically, within and among organizations. Too often the planner's efforts are restricted to one of the organization's activities – land use controls, for example – or to one level, such as the strategic, with primary emphasis on getting a "comprehensive plan" adopted. For environmental issues this limited approach will seldom be sufficient. For instance, even in the rare case where the appropriate degree of environmental awareness and committment *has* been achieved at the top level of decision-making, there is a good possibility that it will not filter down to those immediately responsible for actions which may degrade specific environments – the bulldozer operator whose morning's work unknowingly wipes out a rare wildlife habitat (drawing an example from a recent experience on the Toronto waterfront). Field personnel often have considerable discretion to alter plans as field conditions dictate. Environmental capacity, quality and resources can easily be lost through default if planners and managers forget that plans at one level, instead of directly guiding implementing action, are often merely inputs to more detailed plans, right down to preparation for the last action affecting an environment of concern (e.g. route alignments, contractor's working drawings, dozer operator's grade sheets). Needed is environmental input, worked out with those responsible for implementation, into *each plan* along the line. Such "activity-sequence planning" can be top-down, connecting overall policies to specific environmental resources; or it can be bottom-up beginning with the environment and identifying all activities that would affect it adversely, then attempting to build environmental considerations into whatever planning guides these activities.

A further argument can be made: the inadequacy of relying too heavily on environmentally oriented land use plans. While the land use planner may regard the building of a road or construction of new housing project as implementation of the overall land use plan, the works department or the land developer are likely to see their projects as implementation of their own plans, to which the land use plan is only one among various inputs. Again, sequences of plans and a multiplicity of interests are involved. Also worth noting is that creating an environmentally sound land use plan, while undeniably important, occurs as only an occasional opportunity. Furthermore, where an area

is already "developed", emphasis switches to use – to the organizing, directing and controlling of ongoing human activities, and to "management" of the environment.

Control is the obverse of planning. The control function itself, applied to both public and private activities, offers a significant opportunity to intervene environmentally. Various incentives, disincentives (such as penalties for environmental degradation, or publicizing such actions) and other control measures are needed to minimize environmental losses, to ensure that pro-environmental objectives are being achieved, and to compensate for the limited predictive capability of the environmental planner.

Monitoring and evaluation are two forms of control, though seldom seen as such. They may include:

Pre-action evaluation that subjects specific proposals for development or change to rigorous environmental analysis and public scrutiny for the purpose of identifying and preventing or mitigating adverse environmental effects before commitments to implementing action become irrevocable. Environmental impact assessment (Section 5.5) is an increasingly common form of pre-action evaluation.

Post-action monitoring, to keep track of environmental change whether foreseen or not, accompanied by *periodic review* and *feedback* to trigger off corrective and preventive action (Section 5.3).

Monitoring, review, feedback, early warning systems and the like, applied to environments of concern, are essential for reasons that go beyond control. Many organizations are not properly managed; much of any environment is not subject to any management whatsoever; and natural/social systems adapt and change in ways that often cannot be foreseen.

Some municipal governments in Canada and numerous governments in the United States are organizing their affairs around concepts of "growth management" (usually referring to population and economic growth). Attitudes toward growth vary from place to place, as Figure 5.3 indicates. Increasingly, growth is coming under critical scrutiny but non-growth has rarely been embraced; an acceptable alternative paradigm remains to be found. Meanwhile the emphasis is turning to growth management as a deliberate purposeful effort to control or influence some or all of the following dimensions of growth:

- Nature and quality (what kind of growth?)
- Amount (how much growth?)
- Rate (how fast?) and timing (when?)
- Geographic location (where?), pattern (distribution), form (density, arrangement of buildings, etc.) and siting (specific location on the ground)
- Demography (who, what groups?).

	Growth is desirable	Growth is not necessarily desirable
Growth is inevitable	Facilitate growth	Control type and location of growth
Growth is not necessarily inevitable	Promote and encourage growth	Manage growth

Figure 5.3 Contrasting Approaches to Population/ and Economic Growth

More sophisticated growth management takes a systems approach, attempting to apply in an *integrated* fashion measures aimed at the foregoing aspects of growth. Environmental management is a more recent variant on the growth management theme, even though it may apply under conditions of non-growth. It involves employing all available powers affecting the human/natural environment with informed foresight in a coordinated manner in accordance with clearly established intent.

Environmental management, encompassing environmental planning, has various components. Most of the following are elaborated, with examples and information sources, in the rest of this chapter. Each has potential for dealing with specific environmental problems and concerns.

Information and *monitoring* systems as the basis for planning, design and management.

Plans and *policies*, whether municipal-wide (e.g. land use, the municipal budget, energy), specific-area (a site plan, for instance) or functional (transportation, housing, education, waste disposal, etc.).

Impact assessment – environmental, social, fiscal – comprising a set of new evaluative tools becoming available to assist municipal

Planning	Organizing	Directing	Controlling
Environmental data base Environmentally oriented land use plan. Environmental components in functional plans. Review capability.	Environmental advisory committee. Environmental coordinator. Interagency coordination. Relating environmental assessment to planning	Political will, committment. Accountability for actions affecting the environment. Incentives and disincentives. Public education.	Environmental policies. Environmental impact assessment. Monitoring and review. Capacity-related development controls.

Figure 5.4 Selected Environmental Management Opportunities at the Municipal Level

decision-makers in comprehending more fully the consequences of proposed actions.

Regulation (zoning, by-laws, control of land subdivision, regulations protecting trees, drainage control, etc.) and *review* processes directed towards proposals from within and without the organization.

Fiscal measures including taxation, economic incentives and disincentives.

Organizational arrangements by which governments can achieve better coordinated and more effective direction and control for environmental purposes.

Participation: actions which open lines of communication to and opportunities for direct involvement of individuals and groups, releasing available energies in the community. And *education* (including demonstration projects, information centres, combinations of incentive and penalty, etc.) necessary to enable effective participation and to achieve behavioural, attitude and value change.

Because environmental problems are interrelated we naturally think of the ultimate ideal approach as one that is fully comprehensive and integrates all of the foregoing components. But, beyond small-scale problems, totally integrated action is likely to be impossible. Usually too little will be known about the man-environment relations in question; control over actions affecting the environment of concern is likely to be fragmented and, for the concerned agency or interest, partial at best; and the required total commitment is highly improbable, considering conflicting interests and demands. "Integration" in practical terms, therefore, will mean operationally relating one initiative – say, a program to protect an environmentally sensitive area – to others that directly affect its chances of success (such as plans to encourage or control development near the E.S.A.), whether within the initiating agency's control or not. Emphasis switches from total understanding and control to *selected systemic action*, attempting to gain understanding of and control over those key aspects of environmental and institutional systems necessary to achieve specific objectives, and maintaining ongoing surveillance leading to new actions and revised objectives. Under this approach "integrated" doesn't encompass everything. It is limited to those things that really count, in the given setting and it does not emerge all at once. More likely is a *building-block* strategy as one way to proceed gradually from immediate problem-response to larger sets of initiatives aimed at wider sets of environmental problems, at causes and not just symptoms, and at preventive as well as corrective action.

Problems arise when governments attempt environmental management, even in a building-block fashion. Four stand out:

1. Limitations on knowledge and data needed for effective management, especially where legal processes are involved; and application of whatever knowledge does exist.
2. Clear definition of the objectives justifying new environmental management measures (which may restrict further the rights of property owners, or at least appear to do so). Measures backed up by sound information and a clear relationship to the public interest are more likely to survive legal and political challenge.

3. Generating in the community the necessary *demand* for and *support* of environmentally oriented action. Environmental problems usually cannot await crisis, but they often lack an organized vocal constituency to advocate their resolution (benefits tend to be longer term and diffused while "costs" of environmental action are immediate and concentrated).
4. Concern, in environmental management, for both environmental *quality* and environmental *equality*. If distributional inequities are inherent in the exploitation of resources in a market economy, the achievement of environmental equality will require fundamental change. Minimizing the inequalities is in itself a formidable challenge.

Environmental management is itself only one component of the overall process of managing the entity in question – municipal governance, for example. Environmental management as seen here is not intended to supersede or even necessarily dominate all other management concerns, although from time to time it may assume major importance. Similarly, environmental concerns seldom lead to massive reorganization even though occasionally (as in San Diego County, for example) this may happen as environmental management becomes the dominant theme of the whole organization.

The fundamental aim, which can be achieved in various ways as the rest of this chapter demonstrates, is to bring environmental and accompanying social considerations prominently into all aspects of management. That includes both the horizontal and vertical dimensions of the organization in question, and it extends to relationships with other effecting/affected organizations and interests in the environments of concern.

Case Study 74
Local-Level Difficulties in Managing the Environment

A recent survey of state and local governments by the International City Management Association cites five major factors inhibiting local environmental management programs (House):

1. Local officials have no clear concept of "the environment". Four definitions were offered to respondents but no one definition received majority support. Officials tended to view it as a complex interrelated problem requiring comprehensive long-range solutions, new techniques and organizational adjustments.

2. Environmental needs compete for scarce resources in local governments.

3. Proven environmental strategies and tools are absent. Sophisticated concepts such as carrying capacity have yet to be translated into operational terms, and successful managerial techniques used by some municipalities are not being communicated effectively to others. Existing tools such as land use controls receive primary emphasis because municipalities have limited statutory capability for innovation. Even where new approaches have been developed, lack of staff to use them has been a problem and their effectiveness has not been evaluated.

4. Confusion exists about the roles and responsibilities among levels of government. Frequently this results in local frustration or inaction.

5. Local environmental management is in a transitional period. Problems are being re-evaluated, policy re-directed, new strategies selected and new resources identified.

Refer to:
Peter W. House, *The Quest for Completeness: Comprehensive Analysis in Environmental Planning and Management* (Toronto: Lexington Books, D.C. Heath, 1976). Annotated in 1.3 Characteristics of Environmental Planning.

Information Resources

See also:
1.3 Characteristics of Environmental Planning
5.4 Plans
5.6 Organizational Arrangements
5.7 Regulation and Review

Ackoff, Russell L. *A Concept of Corporate Planning.* New York: Wiley-Interscience, 1970. Hardcover, 158 pp. $14.75.

Anthony, Robert N. *Planning and Control Systems: A Framework for Analysis.* Boston, Mass.: Harvard University, Graduate School of Business Administration, 1965. Hardcover, 180 pp. $10.00.

Sets up a three-level framework for thinking about management planning and control systems, and shows how to apply it. Appendix A.1 provides a useful overview of various meaning and concepts of "management" and Appendix A.11 does the same for "planning' and 'control".

Berry, Brian J.L. and Horton, Frank E. *Urban Environmental Management: Planning for Pollution Control.* Englewood Cliffs, NJ: Prentice-Hall, 1974. Hardcover, 425 pp. $14.95.

Annotated in 1.1 Environmental Issues.

Boulding, Kenneth E. "Reflection on Planning: The Value of Uncertainty", *Technology Review*, Oct-Nov. 1974.

Burchell, Robert W. and Listokin, David. *The Fiscal Impact Handbook: Estimating Local Costs and Revenues of Land Development.* Rutgers University, Center for Urban Policy Research (Building 4051, Kilmer Campus, New Brunswick, NJ 08903), 1978. Hardcover, 542 pp. $20.00.

Presents methods for projecting the costs associated with residential and non-residential development, methods of projecting revenues, standards for projecting demand for services, and estimates of school children and persons per dwelling unit for predicting future population. See also Thomas Muller, *Fiscal Impacts of Land Development: A Critique of Methods and Review of Issues* (Urban Institute, 2100 M St. NW, Washington, DC 20007), 1975, 60 pp, $2.95.

Carter, S. et al. *Environmental Management and Local Government.* Washington, DC: U.S. Environmental Protection Agency, 1974. 390 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), EPA-600/5-73-016, $3.00 + 25% outside U.S.A.

Presents and analyzes results of a survey of 1 038 U.S. cities, conducted as part of an International City Management Association project on environmental management. The report discusses environment as a policy issue, environmental programs used by cities, federal-state involvement in local environmental management, and problems in managing the environment.

Chevalier, Michel and Burns, Tom. *A Public Management Strategy for Development and Environment.* Environment Canada, Office of the Science Advisor (Ottawa K1A 0H3), 1978. 38 pp. Free.

A paper on public decision-making and management in the context of environment and development. It focuses on the relationships between structures, processes and techniques of public management and their human and natural-environment consequences. Its dual premise is that the theory and practice of public management must be extended to take account of the consequences of public decision-making on man-environment relations, and that the emerging theory of eco-development must be extended to include strategies of public planning and decision. See also Chevalier and Burns, *A Field Concept of Public Management* (Office of the Science Advisor, 1977, 37 pp., free) which argues that, contrary to current thinking, bureaucratic objectives tend to support and build in fragmentation (vertical rather than horizontal integration) and goal conflict. The paper proposes an alternative "field perspective approach" – "a common perspective built across a range of bureaucratic level and function of the effects of individual departmental or agency functions and programs on larger systems of interrelated activity".

Eddison, Tony. *Local Government: Management and Corporate Planning.* Second Edition. London, England: Leonard Hill Books. 1975. Hardcover, £5.00.

Chapter 2, "About Planning", advocates planning as the working context for local government. The meanings, concept and nature of planning are examined; a systems framework is presented for the various kinds of planning local governments undertake; Anthony's three levels of strategic planning, management control and operational control are defined; and several models of planning are critiqued (pure-rationality model, economically rational model, sequential-decision model, incremental change or disjointed-incrementalism model, satisficing model, extra-rational model). The chapter closes with a position statement on local government planning, defined as the "process of preparing a set of decisions for action in the future, directed at achieving goals by optimal means, and of learning from the outcome about possible new sets of decisions and new goals to be achieved".

Edmunds, Stahrl and Letey, John. *Environmental Administration.* New York: McGraw-Hill, 1973. Hardcover, 517 pp. $15.50.

Environmental administration is defined as a concept of managing human affairs in such a way that biological health, diversity and ecological balance will be preserved. It is concerned with providing a congruous interface between nature and human activity (nature being all the biological processes making up the interrelations of organisms with their environment). Sections cover the emerging problem of environmental administration, the ecological system, observing and measuring ecological processes, and the implementation of programs in environmental administration.

Elder, P.S. (ed.). *Environmental Management and Public Participation.* Canadian Environmental Law Association (One Spadina Crescent, Toronto M5S 2J5), 1975. Paperback, 384 pp. $6.00.

A series of papers on various aspects of environmental management in Canada, from the viewpoints of public participation and the law. Annotated further in 5.8 Public Participation.

Finkler, Earl et al. *Urban Non-growth: City Planning for People.* New York: Praeger, 1976. Hardcover, 240 pp. $17.50.

Ford Foundation. *The Art of Managing the Environment.* Ford Foundation (320 East 43 St., New York, NY 10017), September 1974. 42 pp. Free.

Case studies of six Regional Environmental Management experiments whose aim was to solve environmental problems through long-range planning and to develop new institutional arrangements to improve environmental management. The project locations were: Erie County, Pennsylvania; Kaneoke Bay, Hawaii; Seattle, Washington; Nashville-Davidson County, Tennessee; Vancouver, British Columbia; and San Diego, California. Annotated further in 5.6 Organizational Arrangments.

Friend, J.K. et al. *Public Planning: The Inter-Corporate Dimension.* London, England: Tavistock Publi-

cations, 1974. Hardcover, 534 pp. $22.50.

Annotated in 1.3 Characteristics of Environmental Planning.

Gleeson, Michael E. et al. *Urban Growth Management Systems: An Evaluation of Policy-Related Research.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), PAS No. 309 and 310, 1975. 141 pp. $12.00.

A comprehensive analysis and summary of recent (U.S.) local government growth management practice, intended to serve as a policy guide for communities designing their own systems. The report overviews 13 U.S. case studies of operating growth management systems, analyzes the growth management techniques used and comments on the kind of research undertaken in developing the systems. Environmental management was a motivating factor in most of the case studies, second only to concern for the provision of public services. Four kinds of environmental objectives were given for the growth management systems: to prevent or minimize pollution, to prevent or manage interference with natural resources, to protect or enhance the aesthetic quality or character of a place, and to protect the public interest by balancing private development against resource protection. Despite these goals the case studies revealed that the environmental analyses used as a basis for the design of the growth management system were weak or nonexistent. The authors conclude that more guidance is needed regarding what kinds of studies should be undertaken to establish environmental goals, policies and programs to be achieved through a growth management system, and what kind of monitoring and evaluation studies are needed to assess the positive and negative effects of the system.

Hickling, Allen. *Aids to Strategic Choice.* University of British Columbia, Centre for Continuing Education (Vancouver V6T 1W5), 1975. 64 pp. $4.00.

International Reference Group on Great Lakes Pollution from Land Use Activities (PLUARG). *Environmental Management Strategy for the Great Lakes System.* International Joint Commission (100 Ouellette Ave., Windsor, Ont. N9A 6T3), July 1978. 173 pp. Free.

Annotated in 2.3 Water Quality.

Jay, Anthony. *Management and Machiavelli.* Pelican Books, 1970. Paperback, 231 pp. $1.50.

The author contends that management, which is more concerned with people than with machines, markets, products or processes, can only be properly understood in political terms. Machiavelli (*The Prince*) is therefore a more appropriate guide than Peter Drucker. An entertaining, thoughtful book.

Koontz, Harold and O'Donnell, Cyril. *Principles of Management: An Analysis of Managerial Functions.* Fifth Edition. New York: McGraw-Hill, 1972.

One among numerous basic books on management. For a quick introduction to the subject, see: Charles Perrow, "The Short and Glorious History of Organizational Theory", in Kenneth N. Wexley and Gary A. Yukl, *Organizational Behaviour and Industrial Psychology* (Oxford University Press, 1975), paperback, 641 pp. $10.25. A more subtle viewpoint on management is provided by Anthony Jay (above). See also Koontz and O'Donnell, *Management: A Book of Readings*, Third Edition (McGraw-Hill, 1972). Other useful sources on management are: James M. Banovetz (ed.), *Managing the Modern City* (International City Management Association, 1971); for Canadian flavour, W.D.K. Kernaghan and A.M. Willms *Public Administration in Canada: Selected Readings*, Second Edition (Methuen, 1971); Joseph L. Massie, *Essentials of Management*, Second Edition (Prentice- Hall, 1971); and Wexley and Yukl, above especially the section on organization, structure, technology and environment.

Lang, Reg, "Environmental Information in a Planning/Management Context", in Rubec, C.D.A. (ed.). *Applications of Ecological (Biophysical) Land Classification in Canada.* Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1978. Free.

Elaborates the management framework described in this section. Annotated further in 5.2 Information.

Lichfield, Nathaniel et al. *Evaluation in the Planning Process.* Pergamon, 1975. Paperback, 325 pp. $12.95.

This book covers principles governing the use of evaluation in the planning process (referring mainly to urban and regional planning) with implications for the organization and management of studies, and it explores critically recent evaluation practice (seven case studies from the U.K.). "Evaluation" denotes the process of analyzing a number of plans or projects with a view to searching out their comparative advantages and disadvantages and the act of setting down the findings of such analyses in a logical framework. The essence of evaluation, as defined here, is the assessment of the comparative merits of different courses of action. Lichfield's Planning Balance Sheet Analysis, a particular application of the social cost-benefit approach to evaluation, is compared with Hill's Goals-Achievement Matrix method (see Morris Hill, "A Goals-Achievement Matrix for Evaluating Alternative Plans", *Journal of the American Institute of Planners*, Vol. 34, 1968, pp. 19-29).

Linville, J. and Davis R. *The Political Environment: An Ecosystems Approach to Urban Management.* American Institute of Planners (1776 Massachusetts Ave. NW, Washington, DC 20036), 1976. Paperback, 151 pp. $7.00.

The outcome of a national Urban Ecosystems Workshop, this book examines three innovative approaches to environmental management: San Diego County's Integrated Regional Environmental Management experiment; from Tennessee, Nashville-Davidson County's Environmental Planning and Management Project, an overall management capability within the mayor's office; and Columbia (Maryland), a planned new community of about 30 000 in a predominantly rural county. An "urban ecosystems approach" is conceptualized and the accompanying need for institutional change is discussed.

MacDonald, V.N. and Mcleod, Jean. *Corporate Management: Its Role in Local Government.* Toronto: Ministry of Treasury, Economics and Intergovernmental Affairs, June 1978. 47 pp. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $3.00, cheque payable to Treasurer of Ontario.

This paper, part of the provincial-municipal Local Government Management Project, discusses the requirements of corporate management in local government and implementation of a corporate management system. Appendices examine corporate planning and structure planning in the British context.

MacNeill, J.W. *Environmental Management.* Ottawa: Information Canada, 1971. Paperback, 191 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $2.25.

MacNeill, then Director of Policy and Planning in the Department of Energy, Mines and Resources, undertook this study for the Privy Council Office as background information against which federal proposals regarding constitutional powers related to environmental management could be formulated and discussed. The study examines present and future dimensions of environmental management, defined as the application of management ("a process that begins with goal setting and extends through the functions of information systems, research, planning, development, regulation and financing") to the physical-natural environment. It identifies and assesses the range of strategies that various governments in Canada may need to employ, separately and jointly, to respond effectively to environmental management problems. Part One looks at the nature of environmental problems. Part Two identifies some of the demographic, economic, technological and other forces that generate environmental problems. Part Three focuses on urban regions. Part Four examines the environmental problems of rural and territorial areas. Part Five considers the atmosphere and waters, the two resources that transcend activities located in urban and rural areas and receive most of the wastes they generate. Finally, Part Six summarizes the role of governments in environmental management.

Matthews, William H. et al. *Resource Materials for Environmental Management and Education.* Cambridge, MA: MIT Press, 1976. Hardcover, 259 pp. $9.95.

This book is in two parts. The first develops a conceptual framework for considering environmental mangement – "the actions of those involved in decision-making who make a deliberate and systematic attempt to understand how their activities affect the environment and

how their concerns about the environment will affect their activities." Key aspects involved are: identification of the needs and wants of man in his individual and social development; identification of the resources required for such development; determination of how meeting some needs and wants will inhibit or increase the ability to meet others as a result of destruction, degradation or enhancement of resources, identification of the actors who have a stake in the conflicts that arise between meeting needs and protecting resources; and resolution of these conflicts. The second part of the book outlines the substantive bodies of knowledge relevant to environmental management: values and perceptions, ecology, environmental effects, environmental indicators, environmental impact assessment methodology, modelling, monitoring, growth and its implications for the future, economics of externalities, environmental law, administrative processes and actor/role interactions. Each subject is presented in an outline form, intended to be useful both to teachers and managers, followed by a bibliography.

Munson, Michael J., "Environmental Planning: Interorganizational Aspects and Agency Effectiveness", *Growth and Change*, January 1977, pp. 3-10.

Presents the findings of a study of planning and management behaviour (especially with PPBS) at the municipal level in the U.S.A. The paper begins with Anthony's four-part management perspective, then presents concepts and guidelines for effective intra- and interorganizational planning.

O'Riordan, T. *Perspectives on Resource Management.* London, England: Pion Ltd., 1971. Hardcover, 183 pp. $10.00.

The author, in the Dept. of Geography at Simon Fraser University, analyzes concepts of resources and resource management, examines problems of resource allocation (especially common property resources such as air, water and land) and explores the decision-making processes whereby resources are evaluated and allocated. This leads to questions of amenity and disamenity, of how the public and resource managers react to environmental pollution and judge environmental quality, and ultimately of how the decisions which shape our environments are made. Environmental management is covered explicitly in Chapter 5.

Urban Land Institute. *Management and Control of Growth.* ULI (1200-18th St. NW Washington, DC 20036), 1975. $22.50 for three-volume set.

The issues, problems, trends and techniques of growth management are covered in articles by 140 authors.

Acknowledgements 5.2

This section includes contributions from:

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5.2 Information

Information on the existing state of the environment – how it came to be the way it is, how it functions, how people perceive it, what the problems seem to be, what appears to cause them – is vital to the formulation and execution of plans, policies, decisions and action programs. Such information can be descriptive, explanatory or predictive, as Figure 5.5 demonstrates.

The environmental planner experiences a number of problems with information: deciding what information to collect (which includes making choices about the most appropriate balance of understanding between environmental, social, economic, cultural and political factors); defining boundaries of areas for which various data are to be collected; identifying the amount and level of detail to be obtained and making sure this includes essential timeseries; determining who should collect the data; coordinating the inflow of information with the analytic requirements of planning and decision-making processes; sorting out the subjective and the objective and exposing value positions that underlie so-called "neutral" information; considering who shall have access to the information and under what conditions; storing the data for easy retrieval in a manner that builds a permanent base of information and facilitates its updating through monitoring and similar processes; and finding the time and money to do all this.

Planners are called upon to make judgements concerning how much relative effort to expend on reducing each of three types of uncertainty (Friend, Hickling et al.):

1. about the *operating environment* (e.g. the presence of environmentally sensitive areas);
2. about *policy values* to be applied (such as the importance placed on preservation of environmentally sensitive areas vs. their development); and
3. about *choices in related areas of decision* (for instance, other governments' probable actions affecting the environmentally sensitive areas, or what the operators of farms abutting these areas are likely to do to increase or reduce destructive erosion and fertilizer runoff).

Selectivity is one of the thorniest of information problems. However tempting, it rarely makes sense to try to assemble in advance a comprehensive data base for an entire planning area (see Lang). An alternative, "mixed scanning" (Etzioni), involves a quick overview of the whole

	Environment		Information		
Category	**Aspects of Systems**	**Environmental Concepts**	**Main Content**	**Basic Nature**	**Principal Forms**
Basics	Components	Elements Organisms	Classifications Abundance	Descriptive	Lists
	Relationships	Parasitism Symbiosis Predation	Relationships	Descriptive	Texts Matrices
	Space and time	Range Life-cycles Seasons	Distributions	Descriptive	Maps Graphs
Combinations	Structures	Niche Habitat Community	Inter-relationships	Descriptive Predictive	Matrices Diagrams
	Basic processes	Photo-synthesis Reproduction Dispersal	Simple processes Trends	Descriptive Predictive	Graphs Maps
	Change processes	Erosion Succession Evolution	Multiple processes Forecasts	Descriptive Predictive	Diagrams Models Graphs
Multiples	Whole systems	Ecosystems	Systems Measures Impacts	Descriptive Predictive Explanatory	Models Diagrams

Figure 5.5 A Typology of Environmental Information

Source: John Friend et al., *The Environmental Sciences in Regional and Structure Planning. Volume I: Main Report* (Coventry: Institute for Operational Research, 1976). Reproduced with permission.

area at an early stage to pinpoint specific information requirements deserving priority. Too often, excessive effort is given to data collection without clearly identifying the planning, decision and management purposes the data are to serve. Perhaps this is a reaction to the other common extreme where the information requirement is grossly underestimated and planning decisions proceed on the basis of very spotty data. The planner, casting an eye forward to the time when planning proposals will have to be defended before a council or client in a public forum and perhaps even in court, prefers too much data to too little.

The present concern for environmental quality has accelerated development of the technology for collecting information. Remote sensing, for example, is receiving considerable R & D support (see Case Study 82 in 5.3 Monitoring). Increasing attention is being directed towards the nature and quality of the environmental data being collected. Despite the vast amount of environmental information assembled in recent years, much of it is not directly usable in making land use decisions, especially when environmental impacts are a key concern.

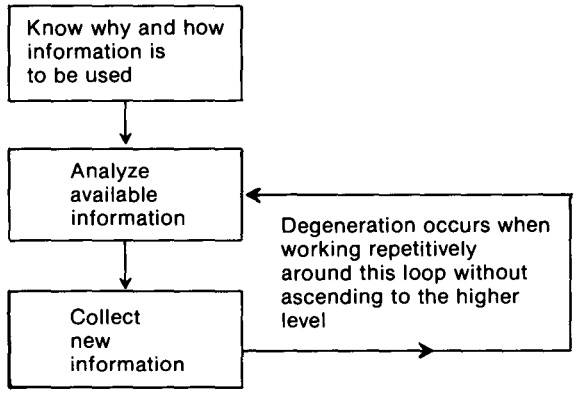


Figure 5.6 The "Degeneration Syndrome" in Information Processes

Source: Reg Lang, "Environmental Information in a Planning/Management Context", in C.D.A. Rubek (ed.), *Applications of Ecological (Biophysical) Land Classification in Canada* (Ottawa: Environment Canada, Lands and Directorate, 1978). Adapted from: Derek Medford, *Environmental Harassment or Technology Assessment* (Amsterdam: Elsevier Scientific Publishing Co., 1973).

Time-series data, for example, collected over a long enough period to describe adequately the current condition and trends of environmental systems, are rarely available. Without knowledge of the baseline condition it is exceedingly difficult to predict how proposed activities will affect natural and socio-economic systems. Recognition of this problem has resulted in greater emphasis on data that will assist in assessing environmental quality, and on describing processes of environmental change. Present efforts to develop methods and approaches for preparing an inventory of environmental resources

and for classifying land reflect this change in perception of the kind of information needed in environmental management.

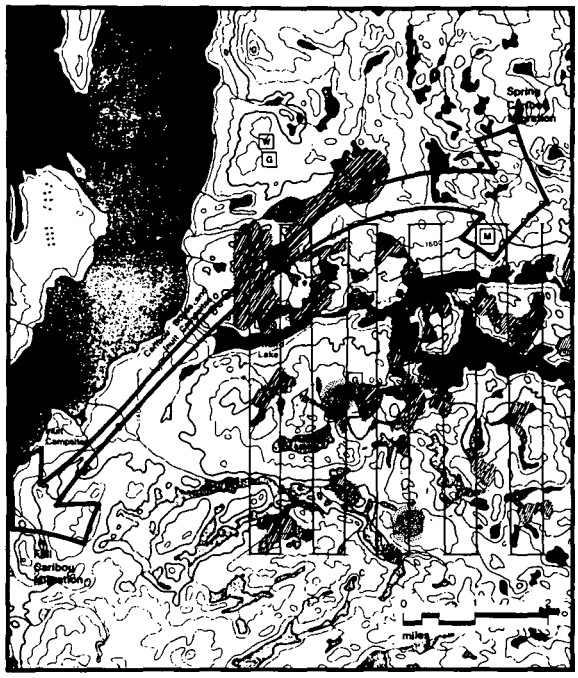


Figure 5.7 Example of a Resource Inventory: Aquatic Sample Sites and Caribou Migration Patterns Near the Amooga Booga Study Area, North-Central Northwest Territories

Source: Wilson Eedy et al., "Application of Biophysical (Ecological) Land Classification in the Environmental Assessment Process: Examples from Various Types of Resource Developments Across Canada", in C.D.A. Rubec (ed.), *Applications of Ecological (Biophysical) Land Classification in Canada* (Ottawa: Environment Canada, Lands Directorate, 1978)

Table 5.1 Summary of Biophysical Information Base for Major Urban Areas in Canada, 1977

Information	Percent of Urban Areas With Information			
	CMAs[a]		CAs[b]	
	1:50 000	1:25 000	1:50 000	1:25 000
Fauna	nil	nil	nil	nil
Flora	nil	nil	nil	nil
Surficial geology	36	nil	7	nil
Bedrock	18	5	17	17
Seismic risk	nil	nil	nil	nil
Geotechnical	86	nil	3	nil
Topographic	100	82	100	23
Soil survey	45	23	58	7
Soil engineering	5	23	nil	nil
Landforms	5	7	nil	nil
Adverse soils	55	46	nil	nil
Groundwater	nil	nil	nil	nil
Flood risk	nil	nil	nil	nil
Climatic	nil	nil	nil	nil

a Census Metropolitan Areas: urban areas with populations exceeding 100 000.

b Census Agglomerations: only CAs or urban centres with population greater than 25 000 were considered.

Source: Ed. B. Wiken, "Ecologically Based Planning: A Report on the CCELC Urban Workshop", in C.D.A. Rubec (ed.), *Applications of Ecological (Biophysical) Land Classification* (Ottawa: Environment Canada, Lands Directorate, 1978).

An *environmental survey* or *inventory* to determine land resources is recognized as a logical starting point for environmental planning. Useful beginnings have been made in soil and vegetation analysis, but, as yet, no uniform approach to classifying and evaluating environmental resources exists (there are even different uses of the word "inventory" and "survey"). Examples of environmental inventories can be found at all levels of government although, as Table 5.1 indicates, the coverage of environmental information in major Canadian urban areas is quite spotty. Approaches taken and methods used vary. Most environmental inventories have been developed for a specific project or program; few are entirely transferable to broader planning contexts. Increasing demand is being shown for environmental information and for comprehensive data coverage, especially in urban areas.

Two fundamental questions underlie environmental resource inventories/surveys: what constraints and opportunities does the environment pose to land use? and what impacts will land use changes have on the environment? The first focuses on satisfying the environmental requirements for urban development, the second on protecting the environment from development. Environmental inventories, then, serve several basic objectives in decision-making about land use:

- To understand key ecological and cultural processes at work in the existing environment.
- To identify the values placed on environmental resources.
- To ascertain the nature and extent of environmental constraints and opportunities.
- To assess the potential impacts of alternative land uses.

- To determine the location, design and operation of land use changes so as to keep adverse environmental effects at tolerable levels.

Natural resource inventories involve five steps:

1. *Obtaining* basic data on the various natural features and processes in the study area through existing data sources, interpretation of aerial photographs and field surveys.
2. *Organizing* these baseline data and presenting them on maps and charts. Usually this involves preparing single-factor or limiting-factor maps for slope, depth to bedrock, flood-prone areas, depth to watertable, etc.
3. *Analyzing* the data, singly and in combinations (e.g. using overlays) to identify capabilities and constraints. Since there is a lack of an agreed system for classifying environmental land units, the analysis of inventory data tends to be largely subjective, influenced by human values and potential uses of the land.
4. *Interpreting* the data for planning and management decisions. This involves determining which areas are suited or inappropriate for what kinds of human activities, or deciding whether a given area of high environmental value can be maintained and at what cost.
5. *Assembling* all the data, raw and interpreted over a range of scales, in a form that can be readily accessed, augmented, updated and generally applied to planning/management decisions.

Data used in steps 1 and 2 are fairly standard, covering such factors as climate, bedrock geology, landforms, soils, hydrology, plant and animal communities, aquatic biology, and land use. Steps 3 and 4, i.e. analysis and interpretation, distinguish the various approaches to resource inventories. In a recent survey of U.S. environmental planning practice, Kaiser noted three general schools of thought:

Natural systems inventory analysis: focuses on specific environmental components or features that limit certain land uses or that need protection against development (e.g. slope, soil texture, groundwater recharge areas, plant species associations). The Canada Land Inventory and the environmental analysis advocated by Ian McHarg are examples of this approach, although McHarg's (see Case Study 79) overlaps with the next one.

Ecosystems analysis: adopts a holistic approach, often with a factor perspective. It stresses the interrelationships among components instead of treating each component as a separate characteristic. A comprehensive examination is undertaken for the whole landscape ecosystem to determine inherent capability for given land use alternatives. Work of the Canada Committee on Ecological (Biophysical) Land Classification and the land classification approach developed by Angus Hills fall into this category, although in practice there is a tendency to return to the preceding approach.

Visual landscape analysis: concerned with evaluating natural systems in terms of their visual or aesthetic qualities and their suitability for such land uses as open space, recreation and highways. Philip H. Lewis, who pioneered visual landscape analysis, has developed an easily understood and applicable approach for recreation planning.

In Canada environmental surveys tend to be either organized along separate disciplinary lines (soil or vegetation surveys, for example) or holistic (such as the Ecological Land Survey) or somewhere between these two extremes (e.g. a soil-landform-vegetation survey that attempts correlations).

McHarg, Hills, Lewis and a handful of other professionals such as Dorney have been instrumental in shaping the methodology of resource inventory and assessment. But the methods are few, poorly documented and often not that easy to apply. Because of this, "guides" to the process of preparing resource inventories, such as those developed by Ashton, Meshenburg, Galantowicz and D. Hill, provide useful starting points.

Some jurisdictions have undertaken comprehensive resource inventory programs complemented by development of *environmental data systems*. The Canada Land Inventory (see 2.4 Soil/Soil Capability) and the Canada Land Data System are examples (see Massam, also Switzer). According to Gardner an environmental data system, oriented primarily toward measuring and signalling environmental change as the basis for planning and management actions, should be capable of:

- Pinpointing the key elements of a given municipality's or region's natural environment.
- Providing accurate information on the current state of each element and of

relationships between them (between climate and vegetation, for example).

- Providing the basis for determining the tolerances of natural resources, their capability for human use and the degree of environmental management required.
- Predicting the environmental consequences of changes to these elements.
- Monitoring changes in environmental systems and land use over time.

Few existing environmental data systems meet all these requirements. One major difficulty is the absence of agreement on environmental measures to describe the state of the environment. Voluminous files of complex environmental data are not very useful in decision-making. Uncertainty can be a function of too much information, not just too little.

Transforming data into forms such as the Air Pollution Index is regarded as one of the most effective ways to communicate information on the status and trends in the environment to decision-makers and the public. The development of *indicators* which summarize two or more environmental variables is a relatively recent trend in the environmental sciences (see Statistics Canada, for example). Several indicators integrated into a single index or series of indices would provide a powerful tool to describe what is happening to environmental quality. The usefulness of environmental indices, however, is presently limited by two factors: the quality of the original data, and the kinds of environmental variables chosen as pertinent to the problem being examined. The comprehensive monitoring necessary to establish environmental change, that would provide selective indicators with the necessary perspective, is lacking.

Case Study 75
Environmental Mapping for the Thousand Island Heritage Area
Submitted by Alan Vaughan, Parks Canada

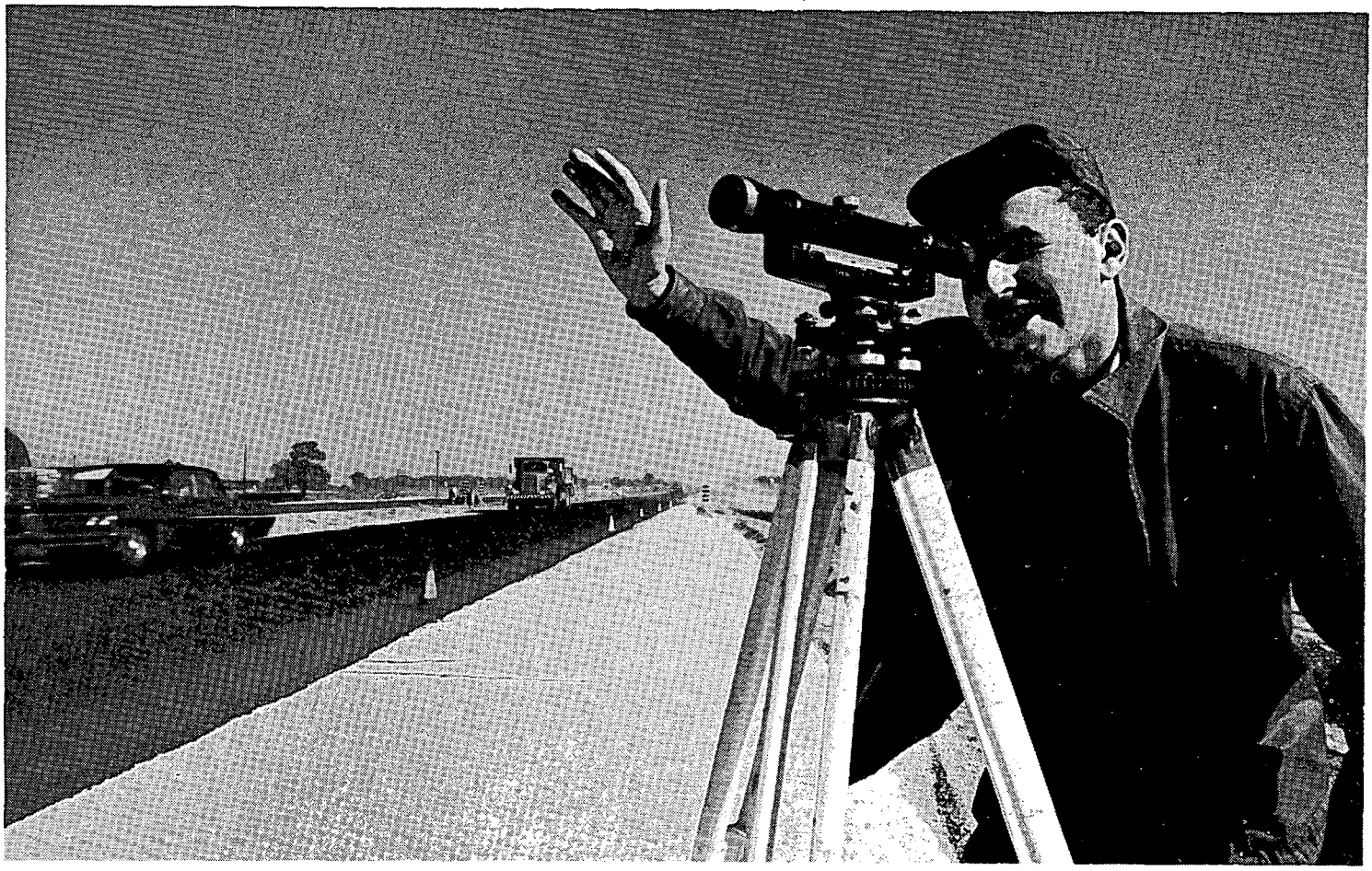
To meet a request of the St. Lawrence Islands National Park Advisory Committee, advising on preparation of a plan for park expansion, Parks Canada undertook a study of the 80 km^2 area affected. Ecologistics Ltd. played a key role in developing the method and associated mapping. The study purposes were to identify: (a) areas that *physically* constrained various development activities, (b) areas that could be disturbed *environmentally* by various development activities, (c) significant environmental features that should be protected, and (d) the significance of environmental changes that could be caused by various types of development activity.

An environmental sensitivity method identified and mapped the extent of *environmental disturbance* that would result from construction, operation or maintenance associated with the 55 types of development activity defined. Primary and secondary effects (including duration and magnitude) on human and natural systems were also identified. Individual acetates (1:10 000) displayed the variable sensitivity of wildlife, vegetation, surface water, groundwater and soils to human disturbance. Matrices were used to present information that translated the general sensitivity rating for each of these five components of the natural environment to specific impact ratings for each type of activity, together with information on the significance of the predicted disturbance. Environmental impact mapping combined with mapping of rare, unique or specialized fish, vegetation, plant, animal, bird or animal habitats gave a better indication of the environmental costs associated with each development. It was noted that although normally every development activity does have a detrimental effect on the environment, not all areas suffer an equal impact.

The study attempted to map this variable tolerance of the landscape at a broad scale. Neither the method nor the base data was site specific; rather, the mapped information indicated the probable environmental responses at a more general level of consideration.

The other half of the study dealt with *physical constraints to development.* Slopes, soil texture, depth to bedrock and water table, and the presence of boulders can significantly increase costs associated with various land uses. Knowing which parts of the landscape cause the least problems can reduce costs and avoid environmental consequences resulting from efforts to make sites suitable for use. Accordingly, three levels of constraint (severe, moderate, and slight or none) were mapped for each of 19 activities. Severe constraint areas represented the highest costs and the greatest difficulty in achieving satisfactory site quality.

The effectiveness of this approach is mixed. Matrices prepared to show the significance of the predicted changes to the environment, although technically sound, were complex and were not



used extensively by the Committee. Mapping and written documentation was of some use to the local Planning Board and to a local citizens action group but it is too soon to determine its value for park planning. Knowledge gained from the study has been useful in designing other studies that include environmental/physical constraints and attempting to clarify for lay persons the *significance* of probable environmental consequences from various types of development.

Refer to:
Ecologistics Ltd., *Environmental Situation Analysis: Supportive Material for Environmental Sensitivity Mapping, Thousand Islands Heritage Area*, Parks Canada, March 1977.

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Case Study 76
Nanaimo Natural History Information Project
Submitted by Bo Martin,
B.C. Ministry of Municipal Affairs and Housing

Nanaimo, on the east coast of Vancouver Island, has many park areas that are coming under development pressure at their borders or are being threatened by over-use. Yet little is known about their plant and animal populations or natural history. The parks, operated by the Nanaimo Parks and Recreation Commission, are regarded by many residents as vacant land even though they are heavily forested and aesthetically pleasing.

In response to this situation the Nanaimo Field Naturalists Club, with Young Canada Works funds, hired three biology undergraduates to conduct natural resource inventories in four selected parks, each subjected to some form of environmental threat (a road, tourist development, residential subdivision, excessive use, etc.)

The result was a substantial base of information on the presence or absence of every species, prominent values and frequency of occurrence, unique attributes, detailed flora and fauna records and other data on the park environments.

Although the opportunities to use this information have so far been few, the Club and other concerned interests are better equipped to take a responsible informed position in future debates on development and use of the parks and adjoining areas. Furthermore, the techniques employed in the project for gathering, assembling and presenting data are transferable to other areas.

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Smithers, B.C.

Case Study 77
Toronto Waterfront Environmental Inventory

Submitted by Linda Cardini, City of Toronto Planning Board

Within the larger context of official plan preparation for the City, the problem of compiling an environmental inventory for an urbanized waterfront under multi-jurisdictional control arose. Minimal funds existed to generate new data. City of Toronto Planning Board staff who coordinated the study, having (at that time) little environmental expertise, organized study groups that borrowed technical people from other agencies to provide guidance and assist in assembling existing information. The planners prepared reports on air quality, physical geography, noise, wildlife and vegetation as well as studies of existing land uses (housing, recreation, industry); reports on climate and on water were contracted out. All studies were written in a non-technical style for ease of understanding by other planners, the public and decision-makers. Wallace, McHarg, Roberts and Todd were hired, with financial assistance from the Province of Ontario and the Government of Canada, to synthesize the specific studies and transform the information into a form directly usable in planning. The results included an easily computerized mapping system, environmental performance requirements, and a method for determining land/water suitability and assessing environmental impacts of development projects.

Both the inventory and the synthesis phases have proved quite useful to planning staff in their preparation of an environmentally sound land use plan. Other agencies, local university classes and interest groups also use the inventory. Recommendations for further studies have received serious consideration by agencies with monitoring capabilities; the inventory itself is designed for additions and updating. Components of the synthesis study, while central to the planners' work, may be beyond the comprehension of citizens including those on the planning committee without detailed explanation by staff. The report's complex coloured (and costly) synthesis maps have not been useful; on the other hand, large-scale black-and-white prints of the resource maps are. Other jurisdictions contemplating similar studies are advised to give close and careful consideration to how the results will be used before determining the final presentation format.

Refer to:
Central Waterfront Planning Committee
City of Toronto Planning Board
235 Queen's Quay West
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(416) 367-7611

Peter de Tolly
Technical Coordinator

Linda Cardini
Environmental Planner

See also: Case Study 97, Conserving Remnant Natural Areas in Toronto's Waterfront (5.7 Regulation and Review)

Case Study 78
The Bay Area Spatial Information Program

Over the past two years the Association of Bay Area Governments has operated BASIS (Bay Area Spatial Information Program), a computer-based tool for handling geographically referenced data in the San Francisco Bay Area. BASIS is structured around an array of grid cells, each representing a land area of one hectare; over two million of these cells are required to cover the nine-county Bay region. Each cell corresponds to a unit of computer storage containing data on the following, with other information being encoded as it becomes available:

- earthquake faults
- ocean/bay coastlines
- precipitation
- geology
- soils
- erosion
- bay depth contours
- airports
- seaports
- vacant industrial

floodprone areas	census tracts
slope stability	transportation zones
well yield	county boundaries
prime agricultural land.	

The BASIS system's ability to manipulate the data base is an important aspect of its usefulness. A composite of many data sets can be produced through overlays and can include distance searches or other calculations. Computer-produced maps and tabulations are the usual outputs. Applications of BASIS (for state and federal rather than local clients) have included: locating potential sites for hazardous waste disposal as a component of ABAG's Environmental Management Plan; creating a data file describing vacant industrial sites; producing a maximum earthquake intensity map for the region; studying airport noise effects; analyzing potential seaports; aggregating population data by geographic area; and supporting a county coastal planning program.

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Case Study 79
McHarg's Natural Systems Inventory

McHarg emphasizes that data should be collected for eight environmental categories in sequence – climate, historical geology, physiography, hydrology, soils, plant associations, animals and land use. Each type of data follows logically from the preceding type. The first three factors determine the next four, and land use will depend on the form and structure of the land units and natural systems associated with them. Greatly simplified, the McHarg inventory and analysis approach has five steps:

1. For each major data category, factors relevant to the study area are selected. For example, in coastal zone areas general information on climate is not very useful while data on hurricanes and areas of inundation are important.
2. Factors are inventoried and evaluated. From geology, features of geologic, scientific and educational value would be identified and graded from unique to abundant. In a study for Medford Township, Pennsylvania, for example, environmental resources were related to a number of social values.
3. Factors are listed and ranked in terms of their relevance to specific land uses. Areas suited to conservation would include features of historic value, high quality forests, bay beaches, streams, water associated wildlife habitats, scenic features, etc.
4. For each land use, overlays combine individual factors to map overall intrinsic environmental suitability (one concern here is that map error multiplies and ordinal numbers are being added). A synthesis map of prospective land uses is then prepared.
5. Compatible and incompatible land uses are separated giving consideration to existing and prospective land uses as well as the social and resource value of delineated natural systems.

Natural-process Value; Degree of Intolerance	Intrinsic Suitability for Urban Use
Surface water	Flat land
Marshes	Forest, woodlands
Floodplains	Steep slopes
Aquifer recharge areas	Aquifers
Aquifers	Aquifer recharge areas
Steep slopes	Floodplains
Forests, woodlands	Marshes
Flat land	Surface water

Much of the strength of this method lies in the comprehensiveness of the inventory and the selective process of identifying, evaluating and interpreting natural system features. The associated professional judgements and the many implicit assumptions make effective appplication of this method heavily dependent on the experience and expertise of the analysts involved.

Some sources:

Development Research Associates, Inc. and Wallace, McHarg, Roberts and Todd, Inc. *An Ecological Planning Study for the Regional Transportation District, Denver, Colorado.* Regional Transportation District (Suite 302, 1050 Yuma St., Denver, CO 80204), 1972. 32 pp.

Juneja, Narenrda. *Medford: Performance Standards for the Maintenance of Social Values Represented by the Natural Environment of Medford Township, N.J.* Philadelphia: Center for Ecological Research in Planning and Design, University of Pennsylvania, 1974, 64 pp. Annotated in 5.4 Plans.

McHarg, Ian. *Design with Nature.* Garden City, NY: Natural History Press, 1969. Paperback, 198 pp. $6.95.

Wallace, McHarg, Roberts and Todd. *An Ecological Study of the Twin Cities Metropolitan Area.* Metropolitan Council of the Twin Cities (Suite 300, Metro Square Bldg., St. Paul, MN 55101), 1969, 105 pp.

See also: Information Resources, this section, especially Harvard University, Hopkins, and Wallace McHarg Roberts and Todd; and Information Resources, 1.3 Characteristics of Environmental Planning, especially Gilliomee.

Information Resources

See also:
2.4 Soil/Soil Capability
5.3 Monitoring
5.4 Plans

Ashton, James. *Natural Resource Inventory: A Training Program for Citizen Conservationists.* Farm and Home Center, Community Resource Development (P.O. Box 259, Millbrook, NY 12545), 1972. Paperback, 56 pp.

A straightforward introduction to natural resource inventories. Proposes a generalized inventory method which involves five steps: 1. determine the objectives and geographic scope of the study; 2. gather materials and tools to be used in conducting the inventory, such as base maps, aerial photographs and soil surveys; 3. classify natural resource items, collect and map data for six natural features (landform, bedrock, soil texture, drainage, topography, vegetation) and 11 cultural features (agriculture, recreation areas, residential areas, commercial areas, industry, institutions, public utilities and services, sanitary landfills and dumps, railroads and air transport facilities, roads, and other significant landscape features); 4. analyse data in terms of community aspirations and objectives, e.g. scenic resources, environmentally sensitive areas, hazard lands, etc. and 5. develop an evaluation system that will provide numerical ratings or scores for potential uses and development of a given site. The report suggests five possible applications for natural resource inventory information: formal planning, community education, legislation, civic and citizen involvement, and environmental impact studies.

Avery, Thomas E. *Interpretation of Aerial Photographs.* 3rd Edition. Minneapolis: Burgess Publishing Co., 1977. Hardcover, 392 pp. $20.00.

B.C. Ministry of the Environment, Resource Analysis Branch. *Catalogue.* The Branch (Parliament Buildings, Victoria V8V 1X4), Jan. 1978. 39 pp. Free.

Lists maps, books, reports and other information available through the Branch's library (839 Academy Close, Victoria).

Canada. Dept. of Indian and Northern Affairs, Parks Canada. *Environmental Analysis: A Review of Selected Techniques.* Parks Canada (Ottawa K1A 0H4), 1973. 145 pp.

Examines the methods and techniques of Hills, Lewis, McHarg, Steinitz, Leopold, Strover and others in terms of approach, advantages/disadvantages and flexibility.

Chanasyk, Victor and Associates. *The Haldimand-Norfolk Environmental Appraisal. Volume 1, Inventory and Analysis. Volume 2, Synthesis and Recommendations.* Toronto: Ministry of Treasury, Economics and Intergovernmental Affairs, 1972. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $10.00, cheque payable to Treasurer of Ontario.

In the late 1960s Haldimand and Norfolk counties, a diversified agricultural area in southwestern Ontario, began to show signs of pressure for urban and industrial expansion (Ontario Hydro generating station, proposed steel mill, drilling for gas, residential development, associated environmental problems). As part of the regional plan-making process, TEIGA commissioned this comprehensive appraisal of the natural, landscape, agricultural, recreational and scenic resources of a 5000 km^2 area. Existing data were to be used rather than field investigations. Volume One fully documents the area's physiographic and biotic resources and their suitability for a variety of uses, from conservation/preservation through forestry, agriculture and fishing to urban and industrial growth. Volume Two integrates this data using a framework based on "principal land uses and general resource considerations".

Christiansen, E.A. (ed.). *Physical Environment of Saskatoon, Canada.* National Research Council (Ottawa K1A 0R6), 1970. 68 pp. $15.00.

A pioneer example of what can be done in bringing together essential environmental information about an urban region – in this case, Saskatoon. The focus is on geology together with pedology, climate and geotechnology (groundwater, slope stability, engineering properties of soils, sand and gravel resources and land use), presented in colour plates with accompanying text.

Coleman, Derek J. *An Ecological Input to Regional Planning.* University of Waterloo, Faculty of Environmental Studies, School of Urban and Regional Planning (Waterloo, Ont. N2L 3G1), 1975. 227 pp.

The first two chapters of this Ph.D. thesis examine ecology and planning and review projects involving ecological inputs to regional planning. A technique is then developed involving a data bank of observations on the natural environment organized on a grid scheme to produce computer maps. Analyses can be made of basic distributions of land uses and soil properties, land capabilities and constraints, desirability scores for different land uses in various areas, hydrologic response, and biological productivity and diversity. The technique was applied to the Regional Municipality of Waterloo which subsequently adapted it for use in regional planning.

Coomber, Nicholas H. and Biswas, Asit K. *Evaluation of Environmental Intangibles: Review of Techniques.* General Press (P.O. Box 336, Bronxville, NY 10708), 1973. Paperback, 77 pp.

A comprehensive classification, review and criticism of economic and non-monetary approaches to environmental evaluation. Includes a 300-item bibliography.

Dalhman, D.W., *Supplementary Aerial Photography in Natural Resource Management: Case Examples from Point Pelee National Park, Ontario.* Dept. of Indian and Northern Affairs, Parks Canada, Natural Resources Division (Ottawa K1A 0H4), 1977.

Two-part study using a manual style in Part 1 to identify the utility of various types of remote sensing and to show the resource manager a step-by-step approach to planning and conducting supplementary aerial photography missions. Part 2 examines five resource management problems at Point Pelee. Advantages and disadvantages of techniques are discussed. See also: Dalhman, *A Role for Supplementary Aerial Photography in the Management of National Parks,* M.Sc. thesis, University of Waterloo, Dept. of Geography (Waterloo, Ont. N2L 3G1), 1978.

Dorney, R.S., "Biophysical and Cultural-Historical Land Classification and Mapping for Canadian Urban and Urbanizing Land", in E.B. Wiken and G.R. Ironside (eds.). *Ecological (Biophysical) Land Classification in Urban Areas. Proceedings of a Workshop, Canada Committee on Ecological (Biophysical) Land Classification, 23 and 24 November 1976, Toronto.* Ottawa: Environment Canada, 1977. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $4.00.

Annotated in 2.4 Soil/Soil Capability.

Ecological Land Survey Task Force, *Ecological Land Survey Guidelines for Environmental Impact.* Environment Canada, Lands Directorate, Ottawa K1A 0E7, 1978.

An information report outlining an ecological approach to collecting and evaluating environmental data.

Environment Canada. *Environment Source Book: A Guide to Environmental Information in Canada.* Environment Canada (Information Services Directorate, Ottawa K1A 0H3), 1978. Paperback, 115 pp. Free from Environment Canada or any of the provincial Environment Departments (see Appendix B, Selected Addresses for Environmental Planners).

This book, prepared jointly by Environment Canada and the provincial/territorial environment and renewable resource departments, is a brief guide to sources of information on the environment in Canada. It provides: summaries of the work of key federal, provincial and international agencies with their addresses and phone numbers; a brief listing of citizen groups in various parts of Canada; a short selective bibliography of current literature on the environment; an introduction to environmental studies in post-secondary educational institutions in Canada; sources of information about environmental meetings and conferences; and a subject index. A comparable source for urban areas is: Ministry of State ofor Urban Affairs, *Directory of Canadian Information Sources* (Ottawa: MSUA, Oct. 1977), paperback, 231 pp. Free.

Etzioni, Amitai, "Mixed Scanning: A 'Third' Approach to Decision-Making", *Public Administration Review*, Dec. 1967.

Mixed scanning is covered in more depth in Chapter 12 of Etzioni's *The Active Society* (New York: Free Press, 1968), annotated in 1.3 Characteristics of Environmental Planning.

Fabos, J.G. and Caswell, S.S. *Composite Landscape Assessment: Assessment Procedures for Special Resources, Hazards and Developmental Suitability.* University of Massachusetts, College of Food and Natural Resources (Amherst, MA 01002), Bulletin 637, 1977. Paperback, 323 pp.

Friend, John, Hickling, Allen et al. *The Environmental Sciences in Regional and Structure Planning. Volume II: A Guide for Planners and Scientists.* Institute for Operational Research (4 Copthall House, Station Square, Coventry CV1 2PP, England), July 1976.

Environmental information and its role in planning and policy formulation are discussed in this provocative paper, annotated in 1.3 Characteristics of Environmental Planning.

Galantowicz, Richard E. *Natural Resource Systems: A New Basis for Shaping the Redevelopment of Newark.* North Jersey Conservation Foundation (300 Mendham Road, Morristown, NJ 07960), 1975. 30 pp.

First report on the findings of the North Jersey Conservation Foundation's project called "The Application of Natural Resource Planning Concepts to Urban Environments". The report makes the case for including natural resource inventories as part of the urban planning process, arguing that such information is directly relevant to the City of Newark's problems of flooding, pollution, water shortages, transportation and a generally unattractive artificial landscape. Galantowicz outlines the kind of data that should be collected and how it can be used.

Galantowicz, Richard E. *The Process of Environmental Assessment – Options and Limits. Part II: Natural Resource Inventory for Municipal Fun and Profit.* North Jersey Conservation Foundation (300 Mendham Road, Morristown, NJ 07960), Nov. 1972. 57 pp. $2.00.

Part of a series aimed at providing practical information to municipal officials and interested citizens about environmental assessment and its use in local planning, this publication explains what a natural resource inventory is, who should carry it out and when, and how to do it. Most of the report is appendices including: Chapter 7, "Natural Resource Inventory" of *Environmental Commissionner's Handbook*, published by the New Jersey Dept. of Environmental Protection (P.O. Box 2809, Trenton, NJ 08625), 1973; and the Passaic Township Natural Resource Study.

Gardner, James S. *A Study of Environmental Monitoring and Information Systems.* Fort Belvoir, VA: U.S. Army Engineer Topographic Laboratories, 1972. 292 pp. Available from National Technical Information Service (5285 Port Royal Rd, Springfield, VA 22161), AD-739 553, $12.25.

Annotated in 5.3 Monitoring.

Gladstone, Arthur. *Environmental Information Guide for B.C. Canadian Scientific Pollution and Environmental Control Society* (1603 West 4th Ave., Vancouver V6J 1L8), July 1977. 25 pp. Free.

Lists books, periodicals, films and slideshows, educational programs, organizations and government agencies.

Greer, Karen H. et al. *A Directory of Computerized Environmental Information Resources.* Lexington, KY: Institute for Mining and Minerals Research, Oct. 1976. 46 pp. Available from National Technical Information Service (5285 Port Royal Rd, Springfield, VA 22161), PB-262 486, $4.00.

A selected listing of computerized environmental information resources for such topics as air pollution, pesticides, soil data, energy, noise, oceanography, nuclear science and water.

Hammond, Kenneth A. et al. (eds.). *Sourcebook on the Environment: A Guide to the Literature.* Chicago: University of Chicago Press, 1978. 613 pp. $20.00.

Harvard University, Graduate School of Design. *Three Approaches to Environmental Resource Analysis.* The Conservation Foundation (1717 Massachusetts Ave. NW, Washington, DC 20036), 1967. 102 pp. $2.00.

Describes the approaches of Hills, Lewis and McHarg.

Hill, David E. and Thomas, Hugo F. *Use of Natural Resource Data in Land and Water Planning.* University of Connecticut, Connecticut Cooperative Extension Service (Storrs, CT 06268), 1972. 47 pp.

The report describes how geologic, hydrologic and soils data can be integrated to provide a base for land and water use planning. First, the basic sources of natural resource data (topography, bedrock and surficial geology, hydrology, soils and land use) are described and problems of integrating data to a common base and scale are discussed. Second, from basic resource maps and accompanying data, 26 single-factor maps are developed to delineate areas having common characteristics such as steep slopes, bedrock at shallow depths, high water table, flooding, availability of groundwater supply and land use. And third, a pilot case study is presented to show how single-factor maps can be used to identify areas with favourable or unfavourable characteristics for a variety of uses such as sanitary landfills, on-site disposal of septic tank effluent, and transportation and public utility corridors.

Hills, G. Angus et al. *Developing a Better Environment: Ecological Land-Use Planning in Ontario, A Study of Methodology in the Development of Regional Plans.* Toronto: Ontario Economic Council, 1970. Paperback, 102 pp. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $3.00, cheque payable to Treasurer of Ontario.

Annotated in 2.4 Soil/Soil Capability.

Hopkins, Lewis D., "Methods for Generating Land Suitability Maps: A Comparative Evaluation", *Journal of American Institute of Planners*, October 1977, pp. 386-400.

See 2.4 Soil/Soil Capability.

Kaiser, Edward J. et al. *Promoting Environmental Quality Through Urban Planning and Controls.* Washington, DC: U.S. Environmental Protection Agency, 1974. 441 pp. Available from U.S. Government Printing Office, (Supt. of Documents, Washington, DC 20402), $4.25 + 25% outside U.S.A.

Annotated in 1.3 Characteristics of Environmental Planning.

Lang, Reg, "Environmental Information in a Planning/Management Context", in Rubek, C.D.A. (ed.). *Applications of Ecological (Biophysical) Land Classification in Canada.* Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1978. Free.

Discusses the role of information in planning and decision processes; examines the dilemma of environmental problems (while environmental systems function holistically, institutional system are disjointed and affected interests are often in conflict) and its implications for generators and users of environmental information; identifies opportunities to diversify information inputs to planning and decisions affecting environments of concern; and suggests a building-block approach to planning that allows discrete initiatives to proceed incrementally but within an integrated environmental management framework.

Lewis, Philip H. Jr. *Regional Design for Human Impact.* Thomas Publications Ltd., 1969. 157 pp.

Luff, D.O. and Ojamaa, P.M. *The Value of Ecological (Biophysical) Land Classification in Land Use Planning: An Alberta Case Study.* Alberta Energy and Natural Resources, Resource Evaluation and Planning Division (9915-108 St., Edmonton T5K 2C9), 1978. 11 pp.

Deals with the Wapiti-Grande Prairie Sand Dunes, described as Case Study 70 in 4.6 Recreation.

Lyle, John and Von Wodtke, Mark, "An Information System for Environmental Planning", *Journal of American Institute of Planners*, November 1974, pp. 394-413.

Describes the San Diego Environmental Information System, a component of the County's Integrated Regional Environmental Management Program. IREM's purpose is to develop new methods and processes for local government to manage the physical environment on a regional scale. The Information System was designed to identify optimum locations for development on the basis of natural processes, to make qualitative predictions of environmental effects of proposed developments in order to evaluate environmental impact, and to determine what human activities would bring about the least change in natural processes on given sites. The Information System is based on analyses of the interactions of location, developmental actions and environmental effects. With any two of these factors, the third can be determined by applying the hypothesis that particular developmental action in given locations will bring about certain predictable effects. Flow diagrams based on the work of H.T. Odum (see 2.7 Energy) were used to describe ecological processes of material and energy flow. To determine locations the study area was divided into cells based on horizontal grid coordinates. By combining the horizontal grid with the flow diagrams, it is possible to locate and inventory important environmental variables in the three dimensions of space. The system is designed to work with location data and material and energy flows at three scales: regional long-range planning, areas up to 100 square miles, and local or site planning for areas up to ten square miles.

MacDougall, E. Bruce and Brandes, Charles E. *A Selected Annotated Bibliography on Land Resource Inventory and Analysis for Planning.* Penn. Dept. of Property and Supplies (State Bookstore, 10th and Market Streets, Harrisburg, PA 17125), 1974. 36 pp.

Man and Biosphere Canada. *MAB Information System Compilation 2.* Canadian MAB Program (Environment Canada, Liaison and Coordination Directorate, Ottawa K1A 0H3), 1978. Free.

The UNESCO Program on Man and the Biosphere (MAB), launched in 1970, is an international intergovernmental research program designed to establish, within the natural and social sciences, a national basis for managing the resources of the biosphere. Fourteen project areas have been established, four of which were selected for concentrated activity in the Canada/MAB Program: urban systems, agricultural and forestry management practices, coastal ecosystems and the North. Further information is available from Dr. Patricia Roberts-Pichette, Executive Secretary of the Canada/MAB Program.

Marsh, William M. *Environmental Analysis for Land Use and Site Planning.* New York: McGraw-Hill, 1978. Hardcover, 292 pp. $22.50.

Annotated in 1.3 Characteristics of Environmental Planning.

Massam, B.H. *An Evaluation of Geo-Information Systems with Special Reference to the Canadian Geographic Information System: The User's Viewpoint.* Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1974. 53 pp.

Medford, Derek. *Environmental Harrassement or Technology Assessment?* Amsterdam: Elsevier Scientific Publishing Co., 1973. $15.95.

Meshenberg, Michael J. *Environmental Planning 1: Environmental Information for Policy Formulation.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), P.A.S. Report No. 263, November 1970. 52 pp. $6.00.

Useful in the early "warm-up" stages of a resource inventory. Focuses on the kinds of information that should be collected on land (soil, topography, rock, minerals), water (subsurface water, surface water, coastal zone), air (climate, pollution), vegetation and wildlife, and land use.

Murray, Timothy et al. *Honey Hill: A Systems Analysis for Planning the Multiple Use of Controlled Water Areas.* Cambridge, MA: Harvard University, Dept. of Landscape Architecture, 1971. 726 pp. Available from National Technical Information Service (5285 Port Royal Rd, Springfield, VA 22161). Vol. 1, AD 736 343, $6.00. Vol. 2, AD 736 355, $3.00.

The appendices introduce the role of the computer in resource analysis and describe systems for handling spatial data.

National Research Council, Study Group on *Environmental Monitoring.* Environmental Monitoring. National Academy of Sciences (Printing and Publication Office, Washington, DC 20418), 1977. Paperback, 181 pp. $7.75.

Chapter 3 discusses management of scientific data with special reference to the U.S. Environmental Protection Agency. Annotated further in 5.3 Environmental Monitoring.

Oswald, E.T. *Gabriola Island – and Neighbouring Island . . . A Landscape Analysis.* Environment Canada, Pacific Forest Research Centre (506 West Burnside Road, Victoria V8Z 1M5), Report BC-X-168, 1977. 39 pp. Free.

This study aimed at providing information for development planning. Ten landscape units and a designation for water bodies are depicted on a map. Each unit is described according to its capability to support various land uses.

Pepper, James E. *An Approach to Environmental Impact Evaluation of Land-Use Plans and Policies: The Tahoe Basin Planning Information System.* University of California, Dept. of Landscape Architecture (202 Wurster Hall, Berkeley, CA 94720), 1972. 152 pp. $4.50.

An M.Sc. (city planning) thesis which reviews the theoretical role of environmental information systems in regional planning, then sets out in detail their application to the Lake Tahoe area.

Quin, A.L. *The Use of Ecological Information in Settlement Planning – A Case Example.* B.C. Ministry of Municipal Affairs and Housing (Parliament Buildings, Victoria V8W 3E1), April 1978. 25 pp.

The case is the Tumbler Ridge townsite project, described in Case Study 85 in (5.4 Plans).

Robinson, G.D. (ed.). *Nature to be Commanded.* U.S. Geological Survey (1200 South Eads St., Arlington, VA 22202), U.S.G.S. Professional Paper 950, 1978. 100 pp. $6.25 prepaid.

Taking its title from a quotation by Francis Bacon, "Nature to be commanded must be obeyed", this book emphasizes the role of earth science information in meeting the need to understand nature in order to obey it. Failure to use such information is apparent in the rapid growth of man-made and main-aided geological hazards. Losses from such occurrences as land subsidence and collapse of slopes due to excavation can be eliminated or reduced if planners and managers are armed with information that indicates the nature, degree and location of potential hazards. This attractive volume contains several hundred colour illustrations, is written in non-technical language, and is designed for use by people involved or interested in urban and environmental planning, design, development and management.

Rubec, C.D.A. (ed.). *Applications of Ecological (Biophysical) Land Classification in Canada.* Environment Canada, Lands Directorate, (Ottawa K1A 0E7), Ecol. Land Class. Series No. 7, 1978. Free.

This volume contains papers prepared for the second national meeting of the CCELC in Victoria, April 1978. Subjects covered include ecological land classification projects in all parts of Canada, methods and approaches applied to various resource activities (agriculture, forestry, wildlife management, recreation, etc.), application of biophysical land classification to environmental impact assessment, and the use of such information in planning and management processes.

Sargent, Frederic O. *Rural Environmental Planning.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), 1976. Paperback, 199 pp. $7.00.

Annotated in 1.3 Characteristics of Environmental Planning. Chapters 4 to 11

provide extensive coverage of "Natural Resource Inventory Analysis and Planning" (inventorying and classifying the natural resource base, keeping land in agriculture, protecting natural areas, planning a lake basin, planning a river basin, aesthetics planning, rural recreation planning, and growth control planning).

Schwartz, Charles F. et al. *Wildland Planning Glossary.* U.S. Dept. of Agriculture, Forest Service (P.O. Box 245, Berkeley, CA 94701), 1976. Paperback, 252 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 001-001-00413-8, $2.45 + 25% outside U.S.A.

One of the better environmental glossaries available; often provides several definitions (with their sources) for slippery words. Similar useful sources include: U.S. Dept of the Interior, Bureau of Reclamation, *Environmental Glossary with Metric Conversion Tables* (The Bureau, Washington, DC 20240), Revised Edition, 1977, 100 pp., free; Gloria J. Studdard, *Common Environmental Terms, A Glossary* (U.S. Environmental Protection Agency, Office of Public Affairs, Washington, DC 20460), 1974, 23 pp., free; Soil Conservation Society of America, *Resource Conservation Glossary* (SCSA, 7515 Northeast Ankeny Road, Ankeny, Iowa 50021), 1970, 52 pp., $5.00; and Paul Sarnoff, *The New York Times Encyclopedic Dictionary of the Environment* (New York: Avon Books), 1971, paperback, 352 pp., $4.45.

Smithsonian Institute. *Planning Considerations for Statewide Inventories of Critical Environmental Areas: A Reference Guide.* Washington, DC: U.S. Department of the Army, 1974. 274 pp. Available from National Technical Information Service (5285 Port Royal Rd, Springfield, VA 22161), $6.50.

Identifies the major issues to be considered in planning, carrying out and implementing a statewide inventory of critical environmental areas. Reviews the state-of-the-art of environmental inventory methods and environmental inventory evaluation systems. The report is heavily referenced to pertinent literature and to existing state programs as of 1974.

Spangle, William and Associates et al. *Earth Science Information in Land-Use Planning – Guidelines for Earth Scientists and Planners.* U.S. Geological Survey (Washington, DC 20242), Circular 721, 1976. 28 pp.

Discusses guidelines for using and integrating earth sciences information in land use planning processes. A "land *capability* study" is defined as an evaluation of the physical features of an area with regard to different types of land use, whereas a "land *suitability* study" considers economic, social and political factors in addition to land capability. Compare the distinction as made by Hills, annotated in 2.4 Soil/Soil Capability.

Stanley-Jones, C.V. and Benson W.A. (eds.). *An Inventory of Land Resources and Resource Potentials in the Capital Regional District.* Ministry of the Environment, Resources Analysis Branch (Parliament Buildings, Victoria V8V 1X4), 1973

The Planning Department of the Capital Regional District, Victoria, requested this comprehensive collection of land-based data from the B.C. Land Inventory. Contents include information on climate, hydrology, vegetation, landscape parameters and interpretations, fish, land suitability for wildlife, recreation, land use constraints and slope classification.

Statistics Canada, Office of the Senior Adviser on Integration. *Human Activity and the Environment.* Statistics Canada (Ottawa K1A 0T6), 1978. $2.80 ($3.40 outside Canada).

Switzer, W.A. *The Canadian Geographic Information System. An Overview.* Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1976. 8 pp.

Thomas, Hugo F. et al. *Manual for Workshops on the Use of Natural Resource Data by Municipal Land Use Decision Makers.* Second Edition. Connecticut Cooperative Extension Service, University of Connecticut (Storrs, CT 06268), n.d. 152 pp.

The materials contained in this extensive manual were used to train local government decision makers to assemble, understand and use natural resource information in their land-use decision-making processes. The workshop focused on developing a series of single-factor maps including soils groups, percolation rate classes, slope classes, depth to bedrock, agricultural land capability, floodprone areas and drainage areas. The manual contains a series of tables listing natural resource consideration for the evaluation of subdivisions and other land use planning proposals.

Thomas, William A. (ed.). *Indicators of Environmental Quality.* New York: Plenum Publishing Corp., 1975. Paperback, 275 pp. $6.95.

Proceedings of a two-day symposium held in 1971 by the American Association for the Advancement of Science, this report examines the state-of-the-art in the development and application of physical, chemical and biological indicators. See also: Thomas et al., *Biological Indicators of Environmental Quality* (Ann Arbor, MI: Ann Arbor Publishers, 1972).

Tomlinson, R.F. *An Introduction to the Canadian Geo-Information System of the Canada Land Inventory.* Ottawa: Department of Regional Economic Expansion, 1967. Contact Environment Canada, Lands Directorate (Ottawa K1A 0E7).

Tomlinson, R.F. (ed.). *Environmental Information Systems: Proceedings of the UNESCO/FGU First Symposium on Geographical Information Systems, Ottawa, September 1970.* Ottawa: International Geographical Union Commission on Geographical Data Sensing and Processing, 1970. 161 pp.

Wallace, McHarg, Roberts and Todd. *Environmental Resources of the Toronto Central Waterfront.* Philadelphia: Winchell Press, 1976. Available from City of Toronto Planning Board (City Hall, 20th Floor, East Tower, Toronto M5H 2N2), $6.00.

Presents an environmental inventory of the waterfront, identifies social objectives from reports approved by various agencies, then interprets the data in the light of those objectives. After identifying environmental (resource) constraints, the report lists performance requirements specifying "those human actions necessary to maintain the resource at the 'norm' at which its value to society is undiminished." Finally, it synthesizes opportunities and constraints for future land use and suggests future planning action. Planners using the performance criteria in evaluating the suitability of land uses along the waterfront.

Wallace, McHarg, Roberts and Todd. *Woodlands New Community: An Ecological Inventory.* Houston, Texas: Woodlands Development Corporation, n.d., about 1974. 85 pp. Available from WMRT (1737 Chestnut St., Philadelphia, PA 19103), $5.00.

One of four volumes (annotated further in 5.4 Plans) on the development plan for a new community, this report covers geology and groundwater hydrology, surface hydrology, limnology, pedology, plant ecology, wildlife, climatology, and landscape as interacting processes. The inventory made three contributions to the ecological planning process: a complete description of existing natural phenomena; evolution of these phenomena over time, representing dynamic natural processes; and the beginning of an "ecological model", indicating interaction between natural processes, which moves the focus from data to design.

Way, Douglas S. *Terrain Analysis: A Guide to Site Selection Using Aerial Photographs.* Stroudsburg, PA: Dowden, Hutchinson and Ross, 1973. Hardcover, 392 pp. $29.50.

Wiken, Ed B., "Ecologically Based Planning: A Report on the CCELC Urban Workshop", in Rubec, C.D.A. (ed.). *Applications of Ecological (Biophysical) Land Classification.* Ecol. Land Class. Series No. 7, Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1978.

Wilson, W.M.C. et al. *A Systematic Approach to Environmental Analysis of Development Plans.* Ontario Ministry of Housing, North Pickering Project (950 Yonge St., Toronto M7A 2K4), 1978. Unpublished draft.

This paper generally describes the environmental inventory and evaluation method used on the 2 000 acre site for the Ontario government's North Pickering new community. Environment is conceptualized as three interacting systems: historical/cultural, biotic and abiotic. Data requirements are defined and tested, especially with reference to "discreteness, factuality, quantitativeness, positiveness and management implications" – criteria deemed

significant for secondary and subdivision plans as distinct from regional and concept plans Three techniques are used in combination to meet these requirements: land division into cells ranging from 0.1 to 5 acres, scoring of cells, and by-cell prestressing of natural areas. To arrive at a rough judgement of land use in the context of a proposed secondary plan (four neighbourhoods of 2 000 persons) a continuum of human use was devised for the site. Areas were designated to-be-undisturbed if they scored high on 13 criteria reflecting unique or rare features or key natural phenomena such as erosion and flooding. At the other end of the scale cells which were heavily disturbed or used (e.g. for agriculture) were designated developable. The 13 criteria included four abiotic (slope, unusual landform, water table or springs, natural watercourse), seven biotic (diversity, unusual flora, unusual fauna, resistant tree cover, age class, stand condition, natural regeneration) and two cultural/historic (adversely disturbed site, cultural features). Criteria scoring was supplemented by a systems score depending on whether a cell was located in a river/valley system, upland wood system, landform system or hedgerow system. Limitations worth noting: the method is oriented to an urban design process; it was applied to an extremely variable site; and forestry was the predominant scientific input although vegetation was used as an indicator of other natural conditions. Outcome: data generated at the upper end of the scale exerted the most influence on the design team (making this, in fact, a "sensitive areas" approach); the team's engineer was unwilling to accept judgements on groundwater or subsoil constraints; and the team generally endorsed the woodlot management prescriptions for certain cells likely to border on residential areas. See also: Information Resources, 5.4 Plans.

Wolff, G.R. (ed.). *Environmental Information Sources Handbook.* New York: Simon and Shuster, 1974. Hardcover, 568 pp.

5.3 Monitoring

Environmental information bases and environmentally sensitive policies and plans do not assure environmentally sound actions. They cannot guarantee that adverse environmental effects will be minimized while conservation of environmental resources is maximized. Relationships between natural, environmental and human activities are usually so complex that total understanding of man/ environment systems and the impact of human intervention would be impossible even if the time, data and expertise were available. Public values toward the environment are difficult to determine and do not remain constant. Actions affecting a given environment are taken by various public and private actors whose ends and means differ. Under such conditions predictive planning cannot be sufficient. Needed to complement it are monitoring and feedback to observe *actual* changes occurring in the environment, to follow up on plans and programs, and to provide various decision-makers and decision-influencers with information that may trigger appropriate responses.

Although the linkage between monitoring and planning is readily apparent – planning flow charts invariably show a feedback loop from the monitoring box back to the beginning of the planning process – explicit discussions of monitoring are rare in the literature of planning and management. In both theory and practice, monitoring receives low priority. A recent survey of 574 practicing planners across Canada (Page and Lang, 1977) found them to be overwhelmingly in favour of conducting monitoring within their planning processes but seldom actually doing it. It is no accident that the lack of monitoring and the scarcity of environmental planning (Lang and Armour, 1977) occur simultaneously.

Where undertaken, environmental monitoring is likely to be used not in planning processes but in connection with specific programs such as water and air pollution control (see Environment Canada) or to keep track of effects of special concern, as a means of compensation for the absence of sensory capability in human beings. An example is the national fallout monitoring program which was established nearly two decades ago during the period of frequent nuclear weapons-testing. For such purposes, monitoring is an activity that is intended to be repeated and that serves to establish baseline or initial states, detect trends, enforce regulations, provide forecasts or warnings, and/or derive possible hazards (Darby). Environmental quality indicators



Acknowledgements 5.3

This section includes contributions from:

Ray Crook
Wilson Eedy
Tom Farrell
Peter Fischer
Stewart Hilts
Gary Paget
Ken Whiteford

of various kinds (discussed briefly in 5.2 Information) are likely to be used to combine related variables into single convenient measures.

Monitoring takes place in both an environmental context and a management context.

In the *environmental* context, monitoring involves repeated observations of human activities affecting natural phenomena and the resulting changes that may affect man. Such monitoring activities fall into three categories (National Research Council):

Source monitoring, the simplest kind, is concerned with what residuals enter or will enter the environment, from what sources and in what amounts. The three familiar kinds of sources are point or stationary (such as specific industries, power plants and sewage treatment facilities), area or nonpoint (e.g. urban land uses, agricultural operations) and mobile (automobiles, for instance, or tankers spilling oil during transport). Source inventories and surveys, often by individual discharges, are commonly used to accomplish such monitoring.

Ambient monitoring is concerned with measuring concentrations of residuals or pollutants in air, water, soil, food and animal tissues. Typically, ambient monitoring is undertaken to determine either how well environmental standards are being met or how environmental quality is changing over time (trends). Surveillance networks, land use inventories, remote sensing, models and baseline surveys are some of the methods used.

Effects monitoring is concerned with the consequences of residuals for humans, animals, plants and materials. Human health effects, including occupational, receive priority. Surveillance of ecological effects provides a means of discovering the degree to which low-level chronic exposures to residuals may affect ecosystems and, potentially, humans. Indicator species are often used.

Problems exist in each of these categories of environmental monitoring (National Research Council). Abatement of pollution receives undue emphasis at the expense of discovering and anticipating environmental problems. Monitoring programs tend to be responses to crisis; as an example, the recent discovery that PCBs are contained in electric transformer stations, and that fires at such locations may release these hazardous substances, produced a call for monitoring of all sites where such hazards may exist. Special studies, hurried legislation to ban various substances and enforcement programs cannot be fully effective responses as long as (a) monitoring programs are fragmented among various agencies, (b) they focus on single pollutants without clear objectives, priorities and criteria and (c) they are not related to a national monitoring system, of the kind Sweden has, for example (Emmelin).

The other context, *management*, refers to the use of monitoring as part of the control function. Such monitoring, according to Anthony, is aimed at assuring that an organization's resources are obtained and used effectively and eficently in the accomplishment of its objectives – seeing that results conform as closely as possible to plans. In recent years, however, the concept of monitoring to review pre-determined objectives (targets of performance) has come under increasing criticism, especially for conditions of high uncertainty and little control. An alternative approach puts the emphasis on monitoring, not to determine whether past objectives and policies have been successfully achieved but rather to keep a watchful eye on those forms of environmental change expected to contribute significantly to present issues and future decisions the authority in question will be called upon to make.

> *It is argued that local authorities exercise only partial control over activities of the communities they serve; that the nature of planning influence in particular is indirect and uncertain; and that the requirement to be responsible to changing community and political pressures adds to the difficulty of monitoring the achievement of any pre-set objectives or targets. An alternative approach is developed which views planning as a process of coping with varying types of uncertainty in such a way as to increase the confidence with which people can make decisions, at an acceptable level of cost in terms of financial and human resources. Where some of the more important decisions involve adjustment of established policy positions. . .this view carries particular implications for the monitoring of background assumptions: of difficulties experienced by decision makers in working with established policies; of pressures for change impinging on the policy-makers themselves; and of newly emergent issues of public and political concern.*(Floyd, Sutton et al.).

A simple model of monitoring, derived from engineering control systems, involves only a few variables with straightforward relationships among them. It is inappropriate in conditions typical of environmental management where planners/managers are dealing with complex, often obscure and bewildering causal relationships, and where they are attempting to influence (being unable fully to control) numerous different interventions by various public and private collectivities and individuals – all within a politically sensitive setting. The emphasis in monitoring then extends beyond those activities described under the environmental context to the following (Floyd, Sutton et al.):

- Keeping track of the key issues identified during preparation of the plan and identifying new issues.
- Regularly reviewing the policies and proposals of the organization in question as well as those of other relevant organizations and interests.
- Monitoring uncertainties that underlie important choices facing the organization/community/region in the future, including the assumptions that were made in order to arrive at commitments already made or being made.

Although the key question remains "what should we monitor?" and selectivity and the use of indices are still major problems, data collection and processing give way in this approach to an *intelligence* function. It stresses communication, flows of information, working with existing organizational structures, the value of qualitative data, personal judgements of key individuals, and the interplay of interests effecting and affected by environmental interventions.

Case Study 80
Monitoring the Alcan Pipeline
Submitted by Gary Paget, B.C. Ministry of Municipal Affairs and Housing

The 800-mile (1 300 km) natural gas pipeline is proposed for construction parallel to the Alaska Highway through mainly Crown land in an undeveloped, unmapped area characterized to a large extent by unstable ground conditions. The absence of lead time for planning, and the difficulties of predicting the impacts given the nature of the development and characteristics of the environment, necessitated a management process with a strong emphasis on monitoring. A monitoring approach along with methods and administrative arrangements are now being considered but no decision has been made yet on a structure for such monitoring.

The recently created Federal Pipeline Agency has responded to the project in a unique way. Terms and conditions being prepared will be attached to a contract between the Government and each of the pipeline companies. Two sets of conditions are contemplated – environmental and socio-economic. In effect these establish substantive and procedural responsibilities of

the parties and cement them in a legally binding agreement. Although the clauses would be enforced by the Agency, they are stated in a manner that allows interpretation as the pipeline proceeds (e.g. "acceptable mitigation plans shall be submitted and implemented").

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Case Study 81
Waterfront Environmental Monitoring Program, Metro Toronto Region
Submitted by Tom Farrell, Metro Toronto and Region Conservation Authority

Creation of parkland along the Lake Ontario shoreline, using clean fill material, offers increased recreational opportunities for people in the Metropolitan Toronto region. To assess the effects of land "creation" on Lake Ontario, the MTRCA in 1975 initiated a program of monitoring development sites prior to, during and after construction. Parameters examined include water quality and temperature, sediment and groundwater quality. Remote sensing is used across the waterfront from Etobicoke Creek on the west to Carruthers Creek in Ajax on the east.

Information accumulated through the program is being used, first, to predict longer-term environmental trends and second, in the implementation of waterfront management strategies. Program findings will aid planning of future waterfront parks and accompanying engineering design. The monitoring program, by providing a sound base of readily available up-to-date information, also decreases the time required for planning and preparing sites for development. An annual report on the program is on view at the Authority offices; a summary is available.

See also:
Beak Consultants Ltd., *Environmental Monitoring Program, Outer Harbour, East Headland and Aquatic Park*, Toronto Harbour Commission (60 Harbour St., Toronto, Ont.), March 1977, 47 pp. + app.

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Case Study 82
Remote Sensing in Canada

In 1971 two events formally launched Canada's program on remote sensing. The Canadian Centre for Remote Sensing was set up to manage and coordinate all federal government remote sensing; and the Department of Energy, Mines and Resources negotiated an agreement with NASA whereby Canada would receive imagery from U.S. resource satellites. ERTS, the U.S. Earth Resource Technology Satellite (now called Landstat), was launched in 1972 and began sending digital data that enabled compilation of some 75 000 photographs of the Canadian landscape.

The information from Landstat, while limited to small-scale mapping, is potentially useful for environmental planning and management in a number of ways:

- Updating maps to reflect changes in land features as a result of river diversions, construction of new highways, urban expansion and the like.
- Identifying geographical features such as fault lines and folds.
- Monitoring the quality and quantity of environmental resources such as water, forest cover and crops.
- Monitoring natural and man-made environmental problems, e.g. siltation, forest fires, oil spills and hurricanes.

Selected sources:

Aird, W.J. *Remote Sensing: Airborne Mission Planning*. Environment Canada, Environmental Protection Service, Environmental Impact Control Directorate (Ottawa K1A 1C8), Sept. 1977. Free.
A training manual prepared to assist users in planning airborne remote sensing missions, with emphasis on aerial photography.

Bird and Hale Ltd. *Surveillance of the Environmental Effects of a Highway Facility by Remote Sensing. A State of the Art.* Ontario Ministry of Transportation and Communications, Research and Development Division (1201 Wilson Ave, Downsview, Ont. M3M 1J8), Jan. 1977.

The first part of this technical report reviews the environmental effects of highway facilities, approaches to environmental impact assessment and remote sensing systems. The second part examines application of remote sensing techniques to environmental impact monitoring.

Canada Dept. of Energy, Mines and Resources. *Remote Sensing in Canada.* Ottawa: EMR, Canada Centre for Remote Sensing (2464 Sheffield Road, Ottawa K1A 0Y7), 1973. 19 pp.

An information brochure describing the Canadian remote sensing program and its applications. The Centre also puts out a regular newsletter and other information materials. Phone (613) 993-0121.

Clough, Donald J. and Morley, L.W. (eds.). *Earth Observation Systems for Resource Management and Environmental Control.* New York: Plenum, 1978. Hardcover, 475 pp. $42.50.

The authors are employed at the University of Waterloo and the Canada Centre for Remote Sensing respectively. The contributors, all experts in their fields, focus on problems related to systems design, organization, development of infrastructure and use of information in decision processes. Divided into three sections – conclusions/recommendations, analyses of systems and application aspects, and detailed background information – the book emphasizes problems of transfering technologies and methods from experimental programs to operational management information systems.

Harper, Dorothy. *Eye in the Sky: An Introduction to Remote Sensing.* Ottawa: Department of Energy, Mines and Resources, 1976, 164 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $5.60.

Written for non-specialists, this book describes remote sensing technology and its application to geology, water resource management, forestry, agriculture and environmental impact assessment.

Hedrick, Wallace E. et al., "Landstat", *Practicing Planner* (American Institute of Planners), December 1976, pp. 18-26.

Describes and evaluates the current status of a program undertaken by the Pacific Northwest Regional Commission (includes the states of Idaho, Oregon, and Washington) to develop an inventory of land resources using remote sensing information as a key component.

Ryerson, Robert A. and Gierman, David M. *A Remote Sensing Compatible Land Use Activity Classification.* Paper presented at the Canadian Association of Geographers Annual Meeting Vancouver, May 1975. Dept. of Energy, Mines and Resources, Canada Centre for Remote Sensing (2464 Sheffield Road, Ottawa K1A 0Y7), Technical Note 75-1, May 1975. 18 pp.

The objective of this report is to provide a preliminary standardized land use classification system, compatible with the CLI, which can be used with remote sensing imagery available in Canada. Two levels of classification are proposed. Level 1 would focus on generalized land use categories with the levels of detail coinciding with CLI land use maps. Level 2 would aim at a more detailed classification of land use with mapping scales of 1:50 000 (for example, urban land use would be subdivided into low-density residential, medium-density residential, high-density residential, commerical, industrial).

Thie, J., "An Evaluation of Remote Sensing Techniques for Ecological (Biophysical) Land Classification in Northern Canada", in Thie, J. and Ironside, G. (eds.). *Proceedings of the First Canada Committee of Ecological (Biophysical) Land Classification; 25-28 May, 1976, Petawawa, Ontario.* Environment Canada, Lands Directorate (Ottawa K1A 0E7), 1976.

Concludes that interpretation of small-scale aerial photographs provides the best cost and data effective method for ecological land classification in Canada. Satellite data should be used in a complementary way to assess and delineate land districts and environmental phenomena.

Case Study 83
Monitoring With the Use of Resource Accounts

The California Environmental Quality Act requires that local-level general plans, economic development plans and related projects/actions be preceded by Environmental Impact Reports (see Case Study 93 in 5.5 Environmental Impact Assessment). Santa Clara County meets this requirement through a single "Master Environmental Impact Report" which evaluates impacts of its General Plan in terms of the processes common to the types of activities under consideration (traffic, liquid and solid waste generation, water and energy consumed, etc.).

Identification of these impacts requires detailed information on the capabilities and limitations of the environmental setting (e.g. for liquid waste, the capacity of sanitary sewers, treatment facilities and the receiving water-body would have to be known). To assist in predicting impacts and to monitor the wide range of impacts resulting from the implementation of land use plans, Santa Clara County is developing a set of "Resource Accounts". The Land Resource Account provides information regarding acreage and location of five categories of vacant land: physically constrained land, service-constrained land, policy-constrained land, land with multiple constraints, and developable land. The Service System Account provides information on the present level of use and design capacity of sewers, roads, drainage, flood control and schools.

In evaluating the General Plan and proposed staged development, the Master Environmental Impact Report draws on the data provided by the Resource Accounts to determine the relationship between the capacities of each service and the demands that would be placed on those services if projected development of the vacant land occurred. As well as assisting in impact evaluations, Resource Accounts can be used to monitor the cumulative effects of development, thus serving as an "early warning" system to identify the need for preventive modifying actions.

Refer to:

Randolph Brodersen and Leonard Ortolano, "Use of an EIR Process in Controlling Urban Sprawl", *Journal of Urban Planning and Development Division* (American Society of Civil Engineering), August 1970, pp. 199-212.

Richard C. Hall, "The Master Environmental Impact Report – A Method for Evaluating the Environmental Impacts of General Plans", *Design Methods and Theories*, Vol. 10, No. 1, Jan.-March 1976, pp. 15-20.

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Case Study 84
Research Support for Rural Water Basin Planning in Ontario's Maitland Valley

Submitted by Ian Deslauriers, Maitland Valley Conservation Authority

Located in southwestern Ontario, the Maitland Valley Conservation Authority is a rural administrative unit, comprising representatives from the municipalities within the watershed and financed by municipal and provincial contributions, concerned with water and related land resources. With a relatively small population and assessment base the unit faces few planning situations of "crisis" proportions. Nonetheless, the watershed is experiencing a steady increase in land use conflicts and rural-to-urban transition. To help channel this growth and reduce its adverse environmental effects, the Authority has been encouraging student, consulting firm and government research. Its concern is: can research and monitoring methods of water and related land resources, be developed to provide an improved data base while remaining affordable?

Despite limited funds the Authority intends to continue its experimental program in research over the next five years. Evaluation of results is ongoing, with a formal review each year prior to budget preparation. The program is considered applicable to other jurisdictions enjoying municipal support and with appropriate executive and support staff.

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Information Resources

See also:
5.1 Environmental Planning in a Management Framework
5.2 Information

Berlin, G.L. *Urban Applications of Remote Sensing.* Council of Planning Librarians (Box 229, Monticello, IL 61850), CPL 352, 1972. $6.50.

Bisselle, C.A. et al. *Monitoring the Environment of the Nation.* 1971. Available from National Technical Information Service (5285 Port Royal Rd., Springfield VA 22161), PB 205990 and PB 2059B0.

City of Calgary, Planning Dept. *Provisional Guidelines for the Development of a Strategic Monitoring System.* The Department, Long Range Planning and Research Division (P.O. Box 2100, Calgary T2P 2M7), Working Paper 3, Feb. 1977 12 pp. $1.25.

Any plan will become obsolete over time unless provision is made for updating it as the need arises, this report argues; this emphasizes the importance of monitoring the "performance" of the plan. *Monitoring*, a continuing activity, is intended to find out what is happening and to identify problems. On the other hand, the purpose of *review*, a periodic activity (annual in Calgary), is to decide what changes of policy are needed. A strong monitoring system is needed to collect and analyze information, to give early warning of actual and potential problems, and to indicate whether policies are working satisfactorily and if not, why not. The report discusses organizing the City's monitoring operation (which is just beginning), the kinds of information to be monitored, and key issues to be resolved in the design and development of the monitoring system.

Canadian Environmental Advisory Council. *Annual Review 1976.* The Council (Environment Canada, Ottawa K1A 0H3), 1978. 81 pp. Free.

Part B of the report, pages 3-81, is titled, "The State of the Environment – 1976" (the 1977 report was not available as of August 1978). A series of brief contributions by individual members of the Council examine air quality, the encroachment of urban development on prime food land, the status of Canadian wildlife, the state of the water environment, nuclear power and the environment, the estuarine environment, and problems of environmental policy-making at the federal level. Annotated further in 1.2 Characteristics of Environmental Problems.

Council of Environmental Quality. *Environmental Quality: The Eighth Annual Report of the Council on Environmental Quality.* Council on Environmental Quality (722 Jackson Place NW, Washington, DC 20006), 1976. Paperback. 445 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 041-011-00035-1, (the 1976 report was $3.50).

The most recent of the Council's annual reports, serving a valuable purpose by regularly monitoring and disseminating key information on the quality of the (U.S.) environment. Describes events of the past year under the headings of pollution (air, water, toxic substances, noise, solid waste) energy, natural resources, human settlements, environmental impact assessment and the global environment. Then examines conditions and trends with respect to environmental health, air quality, water quality, energy, non-renewable resources, population and human settlement, and economics.

Council of Environmental Quality. *Environmental Quality: The Third Annual Report of the Council on Environmental Quality.* Washington, D.C.: The Council, 1972. Paperback, 450 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 4111-0011, $2.00 + 25% outside U.S.A.

Chapter 1, "The Quest for Environmental Indices", pages 3-46, discusses why environmental information is important and the barriers to an adequate system of reporting environmental status and trends. Particularly difficult are collecting accurate and representative data, and analyzing and presenting the data in a comprehensible and meaningful way. Indices are seen as a promising solution to these problems ("index" is defined as a quantitative measure which aggregates and summarizes the available data on a particular problem).

Darby, Ralph et al. *Technical, Intelligence and Project Information System for the Environmental Health Service. Vol. II: EHS Information Network Analysis.* Columbus, OH: Batelle Memorial Institute, 1970. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161), PB 19441.

Dewees, D.N. et al. *Economic Analysis of Environmental Policies.* Toronto: University of Toronto Press, 1975. Paperback, 175 pp. $10.00.

Chapter 5 is titled "Monitoring and Information Cost". The authors note, "A frequent problem in establishing effective pollution control programs is that an effective scheme of monitoring and surveillance is too expensive for the enforcement agency to bear". Measurement problems relate to the quantity of effluent discharged, the difficulty of measuring costs and benefits that would result from a proposed policy or that have resulted from existing policies, and the question of who should bear the monitoring costs. The chapter reviews methods and costs of determining emission rates and the role that measurements play in alternative pollution control policies.

Edmunds, Stahrl and Letey, John. *Environmental Administration.* New York: McGraw-Hill, 1973. Hardcover, 517 pp. $15.50.

Chapter 5 is "The Government as Developer and Monitor".

Emmelin, Lars, "The Swedish Environmental Information System", *Current Sweden*, Jan.-Feb. 1977. Available from the Swedish Institute (P.O. Box 7070, S-103 82, Stockholm 7) or contact the Swedish Embassy (140 Wellington St., Ottawa K1P 5A2).

Describes Sweden's national system for monitoring environmental quality. Further information is available from the Swedish Council for Environmental Information (Jordbruksdepartmentel, Fack, S-103 20 Stockholm, Sweden).

Environment Canada. *The Canada Water Act, Annual Report 1976-1977.* Environment Canada (Ottawa K1A 0H3), 1977.

Reports on the work of committees, progress on water planning and management, flood reduction programs, etc. Various federal monitoring and information systems are mentioned, for example: WATDOC (water resource document reference centre), GOWN (groundwater data storage, processing and retrieval), NAQUADAT (national water quality data bank), STAR (limnological data from the Great Lakes), WATENIS (water effluent national information system), MWDAT (municipal water works and wastewater systems), the Surface Water Data System, and the Glacier Data and Information System. A similar annual report is issued under the Clean Air Act.

Floyd, Michael, Sutton, Alan et al. *Monitoring for Development Planning.* In-

stitute for Operational Research (4 Copthall House, Station Square, Coventry, CV1 2PP, England), Oct. 1977. 99 pp. £2.83 plus postage.

This report, based on an 18-month study for the U.K. Department of the Environment, is addressed to all those in local government who are concerned with keeping track of the changing circumstances which affect the lives of the people they serve, so that they can adapt their policies accordingly. It examines current practice in monitoring and the local planning process, information for monitoring and the institutional context, and the outputs from monitoring. Following a critical analysis of the concept underlying present practice,the authors develop an alternative model for a selective monitoring process to inform policy change. They articulate an issues-based approach comprising the monitoring of (1) issues of concern, (2) policies, programs and decisions, and (3) uncertainties underlying future choices. The last chapter discusses organizational and reporting arrangements.

Ford Foundation. *The Art of Managing the Environment.* Ford Foundation, Office of Reports (320 East 43 St., New York, NY 10017), 1974. 42 pp. Free.

Annotated further in 5.6 Organizational Arrangements. One of the case studies described is the County of San Diego's Integrated Regional Environmental Management approach (see Lyle and Von Wodtke in 5.2 Information). IREM includes a computerized "early warning" system that allows a planner, public manager or private developer to find out whether a piece of land proposed for development has any peculiar qualities that might make development unacceptable for any one of 23 reasons (e.g. excessive slope, insufficient load-bearing capacity, population density, etc.). IREM also monitors environmental change using a set of environmental indices.

Gardner, James S. *A Study of Environmental Monitoring and Information Systems.* U.S. Army Engineering Topographic Laboratories, Research Institute, 1973. Paperback, 292 pp. Available from National Technical Information Service, (5285 Port Royal Rd., Springfield, VA 22161), AD-739-553, $12.25.

Sources on monitoring environmental quality are hard to find. This one, though six years old, usefully reviews operational and proposed schemes for environmental monitoring, discusses remote sensing, describes in detail the key variables by which the physical environment may be described, and outlines an organizational structure for an environmental information/monitoring system.

Gillis, J. et al. *Monitoring and the Planning Process.* University of Birmingham, Institute of Local Government Studies (P.O. Box 363, Birmingham B1J 2T7, England), 1974. Paperback, 104 pp. £1.65.

Haynes, Paul A., "Towards a Concept of Monitoring", *Town Planning Review,* Vol. 45, No. 1, Jan. 1974, pp. 5-29.

Compared to forecasting, simulation and evaluation technologies, scanty treatment is given to implementation-monitoring-feedback-review procedures in planning practice, this paper argues. It examines the concept and potential role of monitoring as an important function of planning in relation to both theory and practice. A systems framework is set out for management of uncertainty. It uses a planning style which relies on a constant inflow of feedback from the real world on the effects and repercussions of both planned and unplanned actions, and it enables re-examination of problems and re-evaluation of policies. Monitoring is concerned with the collection of information about the developing state of the system to which the planning process is being addressed. Monitoring occurs at the interface of the information field and the problem identification function; it selects relevant information from the information field (scanning and screening), arranges and organizes that information (structuring and storing) and disseminates it to appropriate users. The safety-value function of reliable and intensive monitoring, the author claims, would facilitate an organizational climate more receptive to innovation.

Holz, Robert K. (ed.). *The Surveillant Science: Remote Sensing of the Environment.* Boston: Houghton Mifflin, 1973. 390 pp. $10.95.

Horton, Keith, "1400 Instruments Monitor Ontario Air", *Legacy* (Ontario Ministry of the Environment), March 1978, p. 3.

Describes the Ministry's monitoring network, of 1 400 instruments covering 96 areas, to chart the progress of regulations in achieving desirable Ambient Air Quality Criteria set out in the Environmental Protection Act.

Koontz, Harold and O'Donnell, Cyril. *Principles of Management: An Analysis of Managerial Functions.* Fourth Edition. New York; McGraw-Hill, 1968.

Part Six, Chapters 18-31, provides the conventional management view of "control".

Lang, Reg and Armour, Audrey. *Municipal Planning and the Natural Environment.* Toronto: Planning Act Review Committee, 1977. Paperback, 90 pp. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $1.25, cheque payable to Treasurer of Ontario.

Annotated further in 1.3 Characteristics of Environmental Planning. Section 3.1 discusses the concept of and need for an annual "Environmental Audit" at the local level to keep track of environmental change, assist environmental assessment and keep the environmental information base up to date.

Massachusetts Dept. of Community Affairs, Office of Local Assistance. *Monitoring Change in Residential Neighborhoods.* The Office (1 Ashburton Place, 16th Floor, Boston, MA 01209), Dec. 1975. 80 pp.

Though not explicitly "environmental", this study is useful for its method of recording existing data for use in identifying and evaluating community change.

Metropolitan Washington Council of Governments. *Metropolitan Growth Policy Statement: The Metropolitan Growth Policy Program.* The Council (1225 Connecticut Ave. NW, Washington, DC 20036), Oct. 1977. 21 pp. Free.

The COG's Metropolitan Growth Policy Program, begun in 1975, is intended: 1. to provide a metropolitan framework for local government growth management efforts; 2. to assure consistency among the Council's metropolitan planning activities in the areas of transportation, housing, land use, water resources, energy and air quality; 3. to increase communication and coordination among all government agencies in the Washington area; and 4. to assist local government and functional planning bodies to develop locally mandated programs for air and water quality control. Since the Council's function is advisory and coordinative, its main emphasis is on influence and its primary tool is information. The COG continuing planning process includes establishment of information and monitoring systems to forecast regional growth, assess various impacts of growth and provide a basis for revising regional policies. Examples of this approach are provided by the following documents from the Council: *Air Quality Maintenance Planning,* Dec. 1977, 96 pp., free, which sets out the current and projected state of the region's air; *Cooperative Forecasting, Summary Report — 1976,* Dec. 1976, 90 pp, $3.00, which provides short and long-range population and employment forecasts for use in functional and local government planning; and three reports in the Impact Assessment Program for the years 1980, 1985 and 1995, namely, *Land Use and Growth Pattern Implications of Forecasts,* Feb. 1977, 86 pp., $3.00, *Air Quality Implications and Growth Forecasts,* March 1977, 74 pp., $3.00, and *Energy Implications of Growth Forecasts,* April 1977, 88 pp., $3.00.

Metropolitan Washington Council of Governments. *Metropolitan Recreation and Open Space Project Evaluation System.* The Council (1225 Connecticut Ave. NW, Washington, DC 20036), March 1975. 73 pp. Free.

The Project Evaluation System, a form of monitoring (but not a plan or proposed planning policy), is an operational method for systematically describing and evaluating proposed recreation and open space sites within the Washington metropolitan area. Interactions among four independent variables are identified: Resource Quality (individual site characteristics); Use Utility (potential level of use for various park purposes); Probability of Shifts to Urban Use (i.e. to non-park uses); and Readiness-To-Go (ability of public agencies to acquire sites). Indicators of Resource Quality include adaptability of soils, potential for construction of facilities, internal site continuity, slope, relative relief, potential availability, potential

for environmental preservation, level of pollution, woodland vegetation, water recreation potential and historic preservation potential. Each of the other three variables is similarily measured using physical, social, economic and institutional indicators. The System also develops a means for considering interactions among the four variables in the park planning and acquisition process, and it assembles the best-available data base for testing open space alternatives.

National Research Council, Study Group on Environmental Monitoring. *Environmental Monitoring.* National Academy of Sciences (Printing and Publication Office, Washington, DC 20418), 1977. Paperback, 181 pp. $7.75.

Environmental monitoring (interpreted broadly to comprise aspects of the collection, analysis, interpretation and dissemination of scientific data related to environmental problems whether physical, biological, ecological or epidemiological) is essential to the formulation, implementation and evaluation of environmental managment policies to protect human health and wellbeing at acceptable cost, this study concludes. It finds, however, that the U.S. Environmental Protection Agency's current monitoring programs are seriously deficient in three ways: they were undertaken as hasty responses to legislative requirements rather than being based on scientific principles with clear objectives, priorities and criteria related to a national monitoring system; they are based on short-term goals with almost exclusive emphasis on monitoring to control sources of pollution rather than on discovering and anticipating environmental problems; and responsibilities for monitoring are fragmented, with inadequate coordination within and among governments (even among programs) so that existing monitoring programs operate with little or no assessment of their contribution to an overall national environmental program. The report examines these shortcomings in depth and makes a series of recommendations designed to correct them. Appendices include a case study on monitoring in the management of a river basin (the Maumee Estuary), papers on monitoring for genetic effects in man and incorporating uncertainty into environmental regulations, and a directory of monitoring programs and monitoring information centres.

Page, John and Lang, Reg. *Canadian Planners in Profile.* York University, Faculty of Environmental Studies (4700 Keele St., Downsview, Ont. M3J 2R2), June 1977. 11 pp. Free (supply limited).

Presentation, to the 1977 annual conference of the Canadian Institute of Planners in Toronto, of the results of a research project, "Environmental Planning in Canada". The project aimed at identifying the theory underlying the practice of urban regional planning in Canada, contributing to development of a more environmentally oriented planning theory, stimulating debate among practitioners, and augmenting the accumulation of basic data on planning in Canada. Funded by the Canada Council to whom a detailed report on Phase 1 was submitted in 1978.

Patri, Tito et al. *The Santa Cruz Mountains Regional Pilot Study: Early Warning System.* University of California, Dept. of Landscape Architecture (202 Wurster Hall, Berkley, CA 94720), 1970. 297 pp. $5.00.

Information produced through environmental resource inventories and appraisals may be combined with monitoring of urban growth and environmental change to highlight potential and actual conflicts between land use and natural systems/processes. An extension of environmental monitoring approaches found in air quality and water quality management, the Early Warning System is an experimental model for predicting those areas where there is likely to be conflict between dynamic systems and five forms of development: selected residential, logging, tree farming, grazing and specialty crops. An inventory of land-related environmental systems provides the base for the model. Urbanization trends are monitored and projected into the future to identify areas which should be given special attention. With the use of an Early Warning map the planner can identify the areas likely to have impact problems. An impact analysis process provides the additional information necessary to determine the significance of potential impacts and to recommend land use policies for avoiding or minimizing further environmental degradation.

Pennsylvania Light and Power Co. *A Monitoring Study of Community Impacts for the Susquehanna Steam Electric Station.* The Company (Allentown, PA), June 1976. 66 pp. Free.

Annotated in 4.7 Energy Projects.

Schaenman, Philip S. *Using an Impact Measurement System to Evaluate Land Development.* The Urban Institute (2100 M St. NW, Washington, DC 20037), 1976. 106 pp. $3.95.

The system uses monitoring to maintain the necessary data base. Part of a five-report series, annotated under Keyes in 5.5 Environmental Impact Assessment.

Schiefer, K. and Lush, D., "Monitoring Program Needed for Wise Treatment Choices", *Canadian Pulp and Paper Industry,* May 1975.

Waller, John D. et al. *Monitoring for Government Agencies.* The Urban Institute (2100 M St. NW, Washington, DC 20037), 1976. 170 pp. $5.00.

Identifies the major tasks involved in establishing procedures to determine whether program activities are being implemented as planned and whether expected results are occurring. Procedures are presented for establishing an effective monitoring system for a diverse set of projects and examples are described from state agencies (particularly for criminal justice programs). Also available from the Institute: Harry Hartry et al., *How Effective Are Your Community Services? Procedures for Monitoring the Effectiveness of Municipal Services,* 1977, 318 pp., $10.00, which includes discussion of waste collection and disposal, recreation, transportation and water supply.

Wedgewood-Oppenheim, F. et al. *An Exploratory Study in Strategic Monitoring.* University of Birmingham, Institute of Local Government Studies (P.O. Box 363, Birmingham B1J 2T7, England), 1974. Paperback, 104 pp. £1.65.

5.4 Plans

Planning is making mistakes on paper rather than on land (Brainerd). The environmental planning activity is much more complex than this observation implies, however. Circumstances to which planning applies vary widely, especially in terms of (a) the degree of uncertainty associated with the planner's understanding of natural and human environments over which planned action is to be directed, and (b) the degree of control the planner's client has over the actions needed to put the plan into effect. As a result, and because planning as a guiding activity exists at various levels in all organizations, the products of planning vary. There are correspondingly different levels and kinds of plans, in both public and private sectors. For example:

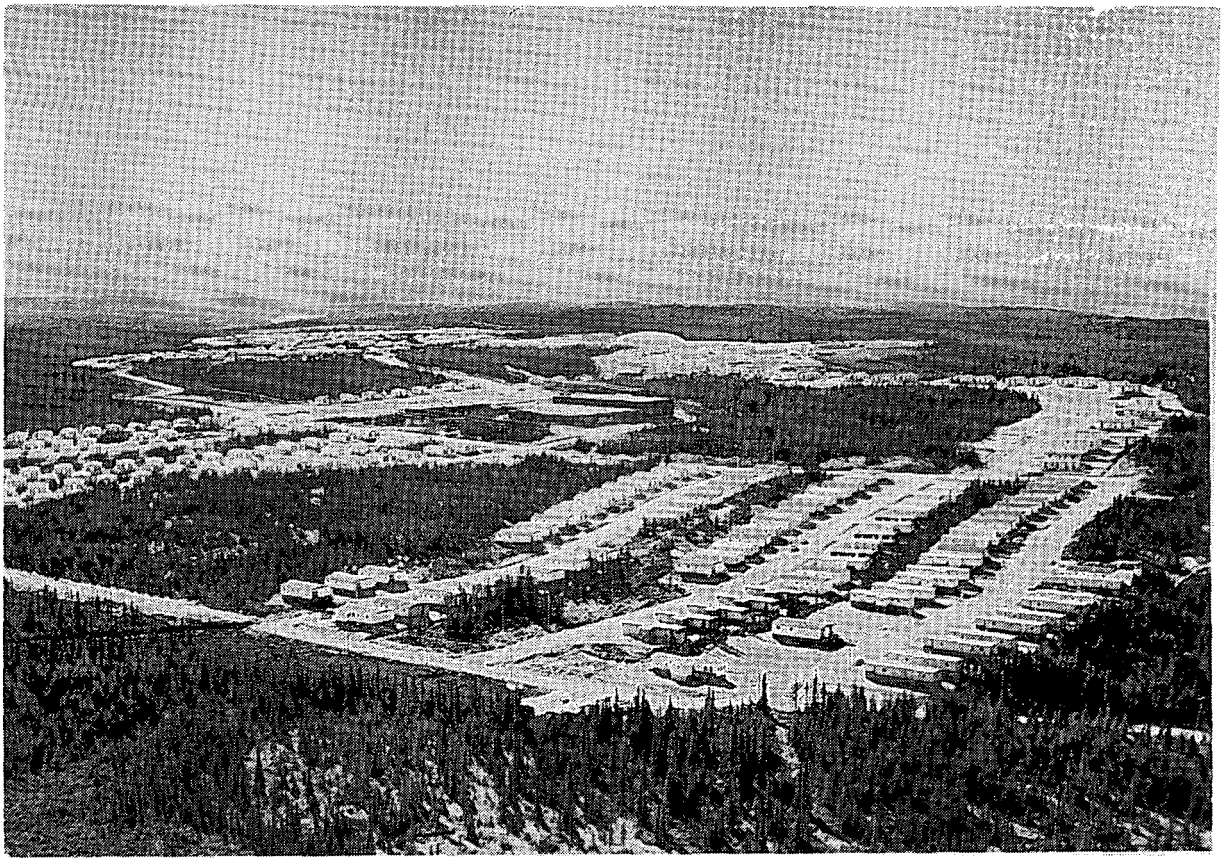
"Strategic" plans vs. "implementation" plans. The former, more concerned with ends, are likely to be deliberately flexible; for example, they will not be legally adopted under procedures that make later revisions difficult. The latter, exemplified by the municipal budget, are more concerned with means and with guiding specific implementing activities. Both kinds of plans are closely related to the management function of *control* – maintaining conformance of the organization's activities as close as possible to its objectives and correcting the objectives when circumstances render them obsolete. Each kind of planning relates closely to the other. The environmental planner's efforts deserve to be directed at both even though the planner is more likely to work at administrative or operational levels than at the strategic.

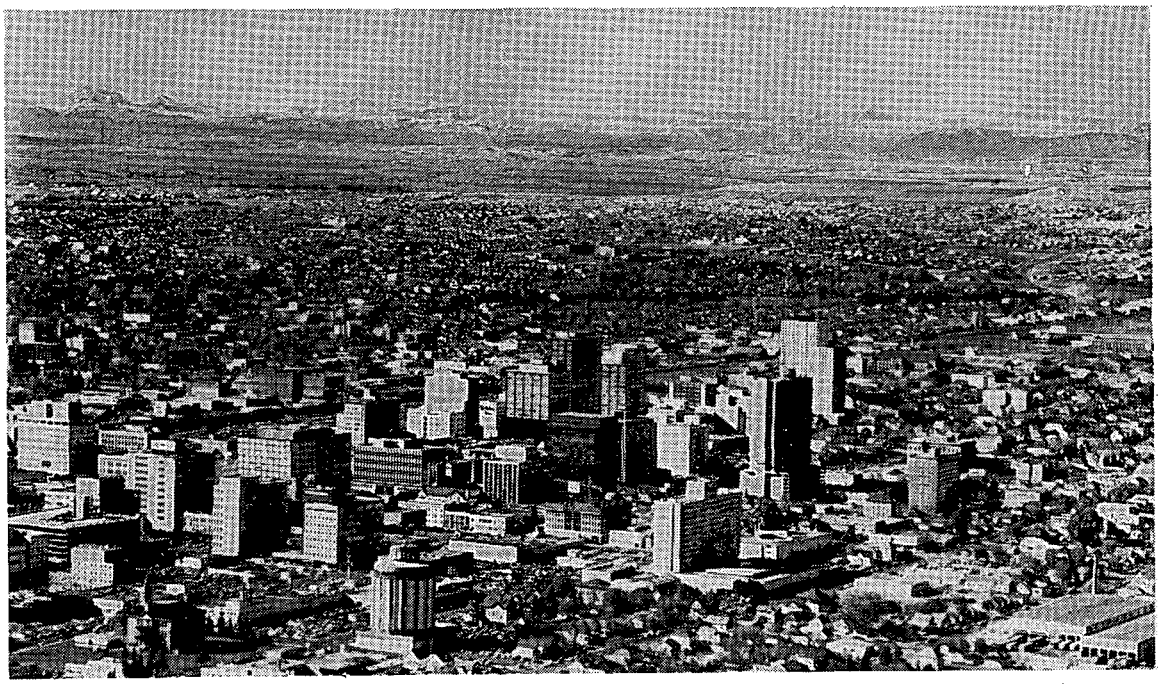
"Comprehensive" plans vs. "functional" plans. Comprehensive plans usually land-use and physical-development oriented, seek to provide guiding frameworks for the functional plans in order that a common base of objectives and data may be used to ensure proper location for specific facilities and coordinate timing of development. In practice the comprehensive-functional relationship is far less certain. Major transportation, water supply and waste disposal facilities tend to be the key shapers of growth in urbanizing regions. Often it is the public or private functional planners, not the so-called comprehensive planners, who determine the nature, amount, rate and location of urban develop-

Acknowledgements 5.4

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ment which is a principle determinant of environmental quality. Environmental planners, therefore, need to diversify their efforts toward both comprehensive and functional plans.

"General" plans vs. "specific" plans. Plans, whether comprehensive or functional, will likely not lead directly to actions affecting specific environments. Instead, they provide input to further, more detailed plans. Environmental planners have to continue their efforts down through sequences of increasingly articulated plans that culminate in construction, operations and site management (Kitchen, 1976). They also need to recognize that initiatives for environmental quality are as likely to emanate from the specific or operational level (e.g. from private developers' plans, especially where development companies are large and able to hire environmental expertise) as from the general or strategic level.

Closely related to 'plans' are *policies* – broad guiding decisions applied to classes of more specific decisions. Policies may be either inputs to or outputs of planning processes. They are a form of management control designed to bring various actions under unified direction in order that the organization's or community's objectives may be effectively served. Sets of policies, related in terms of their application over time, constitute *strategies* (according to Lash, a strategy is a set of policies or means which have mutually reinforcing effects, and aim at not just one but a whole set of objectives). Policy formulation involves: defining environmental problems and identifying environmental issues (which includes a critical analysis of the current condition, how it came to be, what's wrong with it and where it appears to be headed, why the problem isn't solving itself and what barriers stand in the way of possible solutions, what policies have "accumulated" so far and their strengths/weaknesses); devising policy options (which includes identifying key implementing agencies, the positive and negative consequences of pursuing each option, and who would benefit/pay); and formulating policy recommendations (which problem definition, which objectives, which implementing means, which policy option to apply, how to go about it). Policy exists at the interface of *goals* (what we want to achieve) and *jurisdiction* (powers available to achieve the goal). Questions of degree of control over implementing actions and interests supporting or opposing such actions, therefore, become all-important in policy formulation.

In recent years the emphasis in planning practice has shifted from plan to *process*, reflecting a growing awareness of the uncertainties inevitably present and the need for a continuing response. Various models of "the planning process" have been advanced; with special reference to environmental planning, examples include Kaiser, Kitchen (1976), Lassey, Nassau-Suffolk Regional Planning Board, North

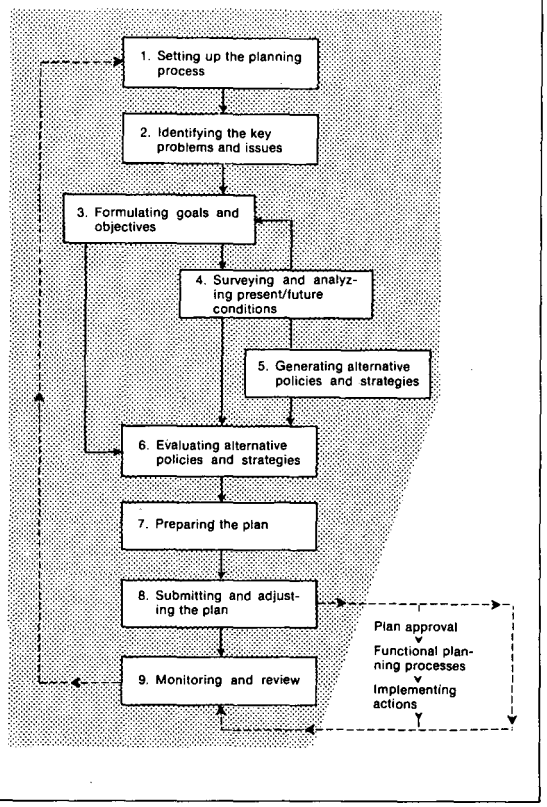


Figure 5.8 A Conventional Urban Planning Process

Pickering Development Corporation (Ontario Ministry of Housing), Ohio Department of Natural Resources, Rutgers University, and Sargent. Most of these, however, refer to *plan-making* processes, dissociating this particular planning activity from its larger management context and therefore separating planning from implementation other than land-use regulation and the review of private-sector plans. A recent survey of Ontario municipal planners (Lang and Armour, 1977a) found that opportunities to increase the environmental sensitivity of plans have tended to be perceived narrowly as one of three: preparing an overall environmental plan for the municipality (rarely done in practice), introducing an environmental section into a municipality-wide plan otherwise oriented to land-use and physical development (more common), or incorporating environmental policies throughout such plans (the favourite approach). The same survey discovered that the environmental priorities of municipal planners extended well beyond those expressed in the plans finally adopted by their municipal councils. Municipal plans lag rather than lead. And the resources needed to prepare legally defensible, politically feasible, environmentally oriented plans – staff, time, money, knowledge, data – seldom seem to be available to municipal governments.

Table 5.2 Environmental Management Strategies in Official Plans, Ontario

Invoking Conservation Authority regulations (found in 42% of the sample) to control land use on environmentally significant sites.

Requesting environmental studies (found in 39% of the sample) of varying scope, usually part of a hazard lands policy in which the effects of the environment on proposed developments are examined. Studies include existing environmental and/or physical hazards, their potential impacts and mitigating measures. Information required for water-oriented proposals or those occurring in environmental protection areas typically includes suitability of soils for septic tanks, impact on water table and water quality, impact on fish spawning areas and on vegetation, and impact on other environmental protection areas.

Applying pollution standards (found in 29% of the sample), either provincial or municipal, in the regulation of land use activities. Such standards often appear as broad goals or policy statements, or in relation to specific activities such as aggregate extraction. Statutory control, liaison with provincial and other authorities, and encouragement of sound engineering practices are the main approaches taken.

Encouraging and controlling tree preservation (found in 20% of the sample), usually a policy directed at aesthetics and most often applied to rural estates.

Relying on municipal or provincial powers to purchase land requiring protection (found in 10% of the sample). A few Plans stated their intent to purchase land in order to protect environmental resources.

Requesting dedications, setbacks and scenic easements (found in 9% of the sample), usually applied as a policy to river valleys, ravines and other environmentally sensitive areas.

Prohibiting use of particular environmental areas (found in 5% of the sample), usually applied to developments occurring in or near stream valleys or marshes.

Requesting land use studies or plans (found in 5% of the sample) as part of the process of reviewing development proposals. Holding categories are also used.

Relying on various provincial agencies (stated explicitly in 2% of the sample). Pollution is the usual concern.

Source: Reg Lang and Audrey Armour, *Municipal Planning and the Natural Environment* (Toronto: Ministry of Housing, 1977). The foregoing resulted from a 36% sample survey (part of the Ontario Planning Act Review) of the 362 municipal "official plans" in early 1976. Nearly two-thirds of these plans were adopted after 1970, the peak of the environmental movement.



Environmental planning faces formidable problems. While capable of being overcome in some of the larger and more affluent jurisdictions, they suggest that the typical environmental planner may have to begin modestly with a number of smaller-scale initiatives rather than with the formulation of a "comprehensive environmental plan". To succeed, however, even small initiatives will require support from the strategic and administrative levels of the planner's organization throughout the life of each initiative. Planners also have to be careful about the form their plans take:

> . . . *The plan to be implemented functioned best when not developed as a detailed blueprint of how the planners wanted the world to look. Instead the plan to be implemented seemed more useful when seen as a set of objectives expressed as a set of guidelines and criteria for evaluating proposed actions. It had to be sufficiently flexible to accommodate financial exigencies and to allow participation by the operating units in the development of detailed project and task proposals.* (Munson).

Below the strategic level, opportunities to introduce environmental considerations depend heavily on the environmental planner's interactions with planners and managers in operating departments. To succeed, environmental planning initiatives need the close continuing involvement of the agencies responsible for detailed planning, design, construction and operations, even though the impetus for such cooperative relationships has to come from the planner. If the planner is already a member of one of these departments – transportation, for instance – success will depend to a great extent on relationships with line managers and field staff. Raising the priority given to environmental factors in functional planning or lower-level operations requires the addressing of assumptions underlying the way things are now done (e.g. behind abatement standards, governing street widths, underlying storm sewer design). It means paying attention to organizational interests; various organizations see themselves as pro-environmental and are astounded when they are criticized for causing degradation. And it requires an awareness of disciplinary and professional biases. The "paradigm" underlying each field can be a significant factor in the environmental stance its practitioners take and the conflicts they encounter with others.

Case Study 85
Tumbler Ridge New Community Plan
Submitted by Gary Paget, B.C. Ministry of Municipal Affairs and Housing

The Province of British Columbia decided to plan for the development of a new town of 10 500 to accommodate employees of anticipated coal developments and other resource activities in a wilderness area of the Alberta Plateau foothills in northeast B.C. (see Case Study 59 in 4.2 Urbanization). The land is owned by the Crown. The area is characterized by ecological constraints (sensitive slopes, floodplain, avalanche zones, high winds, forest fire hazard) as well as opportunities for ecologically oriented planning (diverse vegetation, wildlife corridors, outstanding visual resources, varied topography, recreational opportunities).

Prime responsibility for planning and development of the new community rests with the Ministry of Municipal Affairs and Housing. Also actively participating are a number of other provincial agencies: Forests, Mines, Petroleum Resources, Highways, Public Works and Environment. The conceptual plan which evolved, attempts "to achieve a community that fosters a sense of well-being that seeks innovative solutions to problems of growth, lack of economic diversity and lack of social cohesion, within a framework of environmental, organizational and financial constraints". A conscious attempt was made to "design with nature" and to maximize energy conservation. An integral component of the overall plan is careful management of the environmental resources of the townsite and surrounding region during the period of initial planning, subsequent development and later occupation, and coordination of this urban activity with the various phases of mine, transportation and related development.

Refer to:
Thompson Berwick Pratt & Partners et al. (Richard Rabnett, Project Director), *Conceptual Plan, Tumbler Ridge, Northeast Sector, B.C.: Physical Plan/Social Plan/Financial Plan/Organization Plan*, Ministry of Municipal Affairs and Housing, 1978. 4 volumes.

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Case Study 86
Environmental Planning Parameters for a New Community

The following principles were developed in planning for the new Community of North Pickering, northeast of Metro Toronto:

1. Develop environmental quality *goals*, site-specific but in the regional context.
2. Undertake *field investigations* of existing geology, soils, vegetation, wildlife and archaeological/historical features.
3. Develop *perspectives* of change in environmental resources over time due to human intervention and/or natural processes.
4. Develop environmental planning *standards*.
5. Anticipate *environmental impacts* – ecosystem responses to development proposals.
6. As soon as possible, *renovate* degraded natural systems and *increase stability* of vegetative systems by encouraging diversity to minimize deleterious urban effects.
7. Identify environmental *design* and *construction guidelines* to reduce and control adverse off-site or downstream environmental effects from runoff or waste generation.
8. *Monitor* ecosystem "health" (structure and function).
9. Identify *cost implications*.
10. Identify required *institutional* mechanisms, develop needed *community appreciation* of environmental elements, allow for continual *community participation* in environmental quality issues, and identify *policy implications*.

Refer to:
Ontario Ministry of Housing, North Pickering Development Corporation, *Environmental Management Opportunities and Constraints Within the North Pickering Site*, The Corporation (950 Yonge St., Toronto M7A 2K4), 1975.
See Information Resources.

See also: Case Study 27 in 2.4 Urban Vegetation and Case Study 67 in 4.5 Transportation.

Case Study 87
A Policy Plan for Alberta's Peace River Region
Submitted by Ian Wight, Peace River Regional Planning Commission

The Peace, with 100 000 people spread over one-third of Alberta, is a sparsely populated part of Canada's resource frontier. Though still almost 50% rural, the region is experiencing rapid growth of its urban centres. The Peace has an impressive existing and potential capacity for a wide range of resource developments; on the other hand, its residents particularly cherish its high environmental quality. The region's challenge is to participate in the mainstream of 20th century economic life without jeopardizing quality of environment and community life the people enjoy. How to accommodate resource development within environmental limits at a human scale, therefore, is the general problem addressed in the regional policy plan, prepared by the Peace River Regional Planning Commission comprising 35 urban and rural municipalities.

The final version of the plan, which has been considerably modified from a more environmentally oriented draft, lacks teeth and consistency but retains a general direction in qualified favour of respecting the environment. Policies to preserve good farmland and minimize environmental consequences of resource development are well stated though not yet adequately backed up. The Rural Land Use Policy in the plan is environmentally oriented in a more immediately workable way. It features a section on environmental quality and policies drawing attention to the importance of watershed, airshed and solid waste disposal considerations when evaluating development proposals. Reference is also made to avoidance of noise and safety hazards around airports. The region's lakeshore and landscape (river valley) corridors are to be protected. Although the corridor designation policy is weakened by the absence of specific land use controls, recreation development in these locations is viewed positively and in part from the standpoint of tourism promotion.

To date, opportunities to test the plan have been limited; it has enjoyed mixed success with regard to specific developments. Two problems are: 1. the relative lack of regional growth, which leads to desperation for development in some quarters and a readiness to throw environmental principles out the window; and 2. the seemingly large amount of natural environment available, which promotes complacency over the loss of small amounts to development. The plan has been more successful in mandating further research into regional environmental issues. Major studies have been completed on the region's water resources (see 3.3 Lakes). The plan's environmental theme has also led to participation in provincial government studies on major highway and hydro-dam developments. Finally, the plan facilitated a unique planning education experiment involving a regional news-magazine which regularly reports on environment issues (e.g. a recent issue dealt with appropriate technology).

The plan is now being reviewed and consideration is being given to founding the new plan explicitly on environmental planning principles. To be fully successful, however, this may require a major educational effort which goes beyond the time constraints on the review. Encouragement to move in this direction is provided by the revised statement of purpose of Alberta's new Planning Act which requires plans to "maintain and improve the quality of the physical environment within which patterns of human settlement are situated in Alberta".

Refer to:
Peace River Regional Planning Commission, *Patterns for the Future: A Regional Policy Plan for the Peace River Region of Alberta*, September 1976, 62 pp. + app.; *The Preliminary Regional Plan-Draft, April 1973, 113 pp.; and Patterns for the Future: Draft II*, March 1974.

People, Plans and the Peace, news-magazine available from the Commission.

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Case Study 88
Environmental Analysis, Oro Township Secondary Plan, Ontario
Submitted by Michael Hough, Hough Stansbury + Associates Ltd.

In April 1977, Hough Stansbury and Associates began a resource analysis along a 15-mile section of Ontario's Lake Simcoe in the Township of Oro which has experienced considerable pressure for backshore recreational and estate devel-

opment. Environmental characteristics of the site demanded sensitive planning to avoid water pollution, health hazards and general degradation of aesthetic and biological quality. Septic tanks and individual or municipal water supplies service the area. Local soils have limited ability to accept sub-surface effluent, however, and groundwater quality and supply are major concerns; others include the adjacent Lake Simcoe fishery, the remaining woodlots, geomorphological features and the visual character of the site.

Preparation of a Secondary Plan, as the context for environmental analysis, involved identifying potentials and constraints for development and formulating development policies aimed at quality community and environment. Background information was supplemented with extensive reconnaissance using airphoto interpretation and field sampling techniques. The information was organized according to resource categories such as soil type and depth, slope, water table conditions, wildlife habitat, vegetation and visual analysis. A coding system, depicting the basic resource information for each terrain type, was a valuable step that helped the Council and the public to understand and evaluate inventory results as well as a development capability ranking system devised to integrate all the resource data. Composite terrain units were delineated by overlaying the individual resource maps and evaluated using the ranking system; this map was colour-coded for easy interpretation.

Provincial regulatory personnel, municipal officials, land use planners and the general public appear to have accepted the method as a result of its clear definition and quantification of parameters, concise analysis and graphic presentation. The background environmental analysis served as the foundation for the Secondary Plan and is being used by various levels of government for the review of subdivision applications. Cooperation received from municipal, regional and provincial organizations, and recognition of the need for a detailed environmental basis for the Secondary Plan, were instrumental in the success of this project.

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Case Study 89
Mississauga's Environmental Planning Program
Submitted by Dirk Blyleven, City of Mississauga

Mississauga is a "new" city (created through local government reorganization) located in the Regional Municipality of Peel, immediately west of metropolitan Toronto. It is experiencing rapid urbanization which produces circumstances under which planning – environmental planning in particular – is both urgently required and difficult to accomplish.

Concern for environmental quality by some councillors elected in 1974 led to the formation of an Environmental Advisory Board, a citizens' group that advises the City Council on environmental matters. The Board recommended that environmental planning receive consideration in review of the City's Official Plan. Subsequently, the Planning Department was reorganized to include an environmental control section (comprising one planner). In July 1978 City Council adopted its first Official Plan. Environmental policies included in the Plan establish a comprehensive environmental planning program which recognizes that natural environmental concerns are an integral part of the entire planning process. A three-volume *Mississauga Environmental Planning Program* has been prepared to guide the formulation and implementation of environmental policies. Volume 1, "Environmental Inventories", analyzes elements of natural environmental systems including geology, climate, hydrogeology, surface drainage, wildlife and vegetation. Volume 2, "Environmental Planning Policies", evaluates elements of the natural environment and devises planning objectives and policies. Volume 3, "Environmental Assessment Reports" describes the EA process including content requirements, procedures and guidelines to assist preparation.

Over the past two years the Planning Department has been attempting to implement the draft environmental policies. For example, the Creditview Secondary Plan includes a separate "Environment" report which identifies, analyzes and evaluates natural environments and recommends measures to preserve and manage natural features; plans of subdivision under the Plan will preserve two woodlots. This is a significant achievement considering the fragmenta-

tion of land ownership and the traditional approach to open space.

The Department's approach maps three categories of environmental planning areas, based on an environmental inventory emphasizing woodlots and watercourses. *Environmental Protection Areas* have a high level of environmental significance and ecological sensitivity. Their principal function will be to *prohibit* activities adversely affecting the natural environment; permitted uses include conservation, forestry, wildlife management, horticulture, public open space, agriculture, golf courses, public works and private parkland. *Environmental Policy Areas "A"*, less significant and less sensitive, still have limited tolerance for development; policies seek to *control* activities harmful to the natural environment. *Environmental Policy Areas "B"* have some environmental opportunities and constraints but development can be permitted without seriously affecting natural processes; the primary intent is to *retain* elements of the natural environment in the urban landscape. Supporting this hierarchy in the Official Plan is a requirement for an *Environmental Assessment Report* submitted to the municipality for development in or adjacent to Environmental Protection Areas or woodlots. Such a report will contain both an environmental analysis and an environmental impact statement for review by the environmental planner. Other measures, such as requiring lands below the top of valleys and ravines to be conveyed to the City, complement the foregoing approach.

Refer to:
City of Mississauga, *Mississauga Environmental Planning Program*, Volumes 1-3, 1978.

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Information Resources

See also:
1.3 Characteristics of Environmental Planning
5.1 Environmental Planning in a Management Framework
5.2 Information
5.7 Regulation and Review.

Brainerd, John W. *Working with Nature: A Practical Guide.* New York: Oxford University Press, 1973. Hardcover, 517 pp. $15.00.

British Columbia Ministry of the Environment, Environment and Land Use Committee Secretariat, Resource Planning Unit. *A Land Use Planning Framework.* The Ministry (Parliament Buildings, Victoria V8V 1X4), July 1977. 31 pp.

Clearly written, this booklet is designed to provide a general understanding of the broad patterns of resource occurrence and land use in British Columbia. It discusses landforms, agriculture, fisheries, forestry, outdoor recreation, the visual resource, wildlife, urban suitability, transportation and utility corridors and reservoirs. A profile diagram (below) (included under B.C. Ministry of the Environment, Information Resources, 2.4 Soil/Soil Capability) shows the mix of resource values. A case is made for using the land use planning framework in integrated resource management.

Capital Regional District. *Metchosin Official Settlement Plan.* Capital Regional District, Planning Dept. (P.O. Drawer 1000, Victoria, B.C. V8W 2S6), 1978.

The Metchosin area is located at the southern tip of Vancouver Island adjacent to the provincial capital of Victoria. The Plan provides policies for the environmental management of sensitive areas including lakes, creeks and streams, inland wetlands, marine shorelands, wildlife habitats, original vegetation, unstable soil formations, lands with high erosion potential, and historic man-made environments such as archaeological sites.

Clark, John. *The Sanibel Report: Formulation of a Comprehensive Plan Based on Natural Systems.* The Conservation Foundation (1717 Massachusetts Ave. NW, Washington, DC 20036), 1976. Paperback, 305 pp. $9.00.

The City of Sanibel is a 11 000-acre barrier island just off Florida's Gulf Coast. Its economy is based on tourism (over a million tourists a year), which has raised concerns about preservation of the island's natural qualities in the face of development pressures. With Wallace, McHarg, Roberts and Todd as planning consultants, and with assistance from an ecological inventory by the Conservation Foundation, the City prepared a comprehensive plan dividing the island into ecological zones. Densities, dwelling units and infrastructure services were allocated according to ecological sensitivity and environmental capacities. Measures including performance standards were proposed for protecting natural environmental, economic and scenic resources. Clark documents the Sanibel experience including a history of the island and the results of a natural systems study and provisions of the plan. Appendices deal further with hydrology, vegetation, beach geology, wildlife ecology, estuarine ecology and an energy-based natural systems study (annotated in 2.7 Energy).

Dennison, P.J. *Environmental Factors in Three Planning Studies.* Acres Consulting Services Ltd. (480 University Ave., Toronto, Ont.), n.d., about 1978. 25 pp.

Describes three environmental planning exercises in Ontario: the Hamilton-Wentworth waterfront study, the Simcoe-Georgian area development strategy and the Sarnia-Lambton area planning study.

Dror, Y. *Public Policymaking Reexamined.* San Francisco: Chandler Publishing Co., 1968. Hardcover, 370 pp. $11.25.

A useful general source on the public policy-making process, especially Part II, "A Framework for Evaluating Public Policy-Making" and Part IV, "An Optimal Model of Public Policy-Making". See also: Thomas R. Dye, *Understanding Public Policy* (Prentice-Hall, 1972); James E. Anderson, *The Study of Public Policy* (Praeger, 1975); and G. Bruce Doern and Peter Aucoin, *The Structures of Policy-Making in Canada* (Macmillan, 1971). Unfortunately these and other sources in the policy field tend to focus on policy analysis rather than policy *formulation* which is more the concern of the planner. Friend et al., offer useful observations on policy formulation.

Dubé, Jean et Gravel, Yvon. *Plan pilote d'aménagement intégré des ressources biologiques du territoire de la frayère du ruisseau Saint-Jean, comté de Châteauguay, Québec.* Ministère du tourisme, de la chasse et de la pêche, Direction de la recherche faunique (9530 rue de la Faune, Orsainville, Qué. G1G 5E5), 1978. 52 pp.

A resource management plan for spawning areas, discovered in 1972, on the Saint Jean River. The study was undertaken in response to development proposals on Saint-Louis Lake. The plan recommends measures to protect, restore and ameliorate reproduction areas in the river and examines costs associated with such a management program.

Environment Canada. *Monograph on Comprehensive River Basin Planning.* Environment Canada, Inland Waters Directorate (Ottawa K1A 0H3), 1976. Paperback, 246 pp.

Annotated in 3.1 Streams and Valleys. Progress on river basin plans across Canada is described in Environment Canada, *Canada Water Year Book 1976,* available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $3.50.

Fairfax County Government, Office of Comprehensive Planning. *Growth, Change and the Environment in Fairfax County: The Environmental Planning Process.* Fairfax County Dept. of Environmental Management, Division of Administrative Services (Massey Building, 4100 Chain Bridge Road, Fairfax, VA 22030), Sept. 1974. 99 pp.

Annotated in 5.7 Regulation and Review.

Fraser River Estuary Study. *Interim Information Bulletin.* Environment and Land Use Committee Secretariat (Parliament Buildings, Victoria V8V 1X4), April 1978. 4 pp.

In the Fraser River estuary, a joint federal-provincial study began in February 1977 with the aim of developing a plan and guidelines for the future management of the river/estuarine resource. This involves determination of: the quantity and quality of waste water that could be disposed of in the estuary; means of preserving and maintaining fish, wildlife and waterfowl habitat; appropriate industrial and port development and recreational uses; and, most important, the intensity of use and the degree to which uses can be effectively integrated into the estuary system.

Friend, John, Hickling, Allen et al. *The Environmental Sciences in Regional and Structure Planning. Volume II: A Guide for Planners and Scientists.* Institute for Operational Research (4 Copthall House, Station Square, Coventry CV1 2PP, England), July 1976. 79 pp.

Annotated in 1.3 Characteristics of Environmental Planning. Pages 59-65 deal explicitly with policy-making. The monitoring of policies is covered extensively in Michael Floyd, Alan Sutton et al., *Monitoring for Development Planning,* Institute for Operational Research, Oct. 1977; annotated in 5.3 Monitoring.

Grand River Implementation Committee. *Grand River Basin Water Management Study Information Report.* Ontario Ministry of the Environment, Water Resources Branch (1 St. Clair Ave. W., Toronto M4V 1P5), 1978. Free.

Describes the work of the multi-disciplinary interagency Committee developing "viable water management options needed to plan for and encourage the integrated use of water related land resources in the Grand River Basin". The Committee chairman is Donald Jeffs (address above).

Hall, Richard C., "The Master Environmental Impact Report – A Method for Evaluating the Environmental Impacts of General Plans", *Design Methods & Theories,* Jan.-March 1976, pp. 15-20.

The planning approach of Santa Clara County, California, described in Case Study 83 (5.3 Monitoring).

Hendler, Bruce. *Caring for the Land: Environmental Principles for Site Design and Review.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), P.A.S. Report No. 328, 1977. Paperback, 94 pp. $8.00.

A non-technical book aimed at local planning officials and lay-persons interested in learning about general principles of environmentally oriented site design and the process of reviewing submitted plans for environmental content. The presentations are visually effective in showing not only what to do (in considering hazard areas, for example) but also what can happen if necessary preventive measures are not taken (e.g. if hazardous conditions are disregarded).

Hill, Morris, "A Goal-Achievement Matrix for Evaluating Alternative Plans", *Journal of the American Institute of Planners,* Vol. 34, No. 1, Jan. 1968, pp. 19-29.

One of two classics on the evaluation process in planning. The other is Lichfield, below. Both methods are based on a rational planning model which, various authors note (e.g. Floyd, Sutton et al. in Information Resources, 5.3 Monitoring), has limited validity for situations of high uncertainty typical of environmental planning.

INTASA. *Issues Related to Interfacing Water Resource Planning and Land Use Planning: Development and Application of Quantitative Procedures.* U.S. Dept. of the Interior, Office of Water Research and Technology (Washington, DC 20240), May 1976. 186 pp. + app.

This report addresses the interface between land use planning and water resource planning in the context of regional resource management. Chapters cover the nature of regional planning and its role in resource management; simplified quantitative modeling (based on water/land mass balance) as an approach for regional resource planning; demonstration of the approach in the Platte River Basin; fiscal cost analysis in water and related land resource planning; and site development cost modelling.

International Reference Group on Great Lakes Pollution from Land Use Activities (PLUARG). *Environmental Management Strategy for the Great Lakes System.* International Joint Commission (100 Ouellette Ave., Windsor, Ont. N9A 6T3), July 1978. 173 pp. Free.

Annotated in 2.3 Water Quality.

Jackson, C.I., "Environmental Policy and Environmental Planning in Canada", in McBoyle, G.R. and Sommerville, E. (eds.). *Canada's Natural Environment: Essays in Applied Geography.* Toronto: Methuen, 1976. Paperback, 264 pp. $8.95.

The author, with the Ministry of State for Urban Affairs, examines the basis of governmental concern with respect to natural vs. human environment, traces the growth of environmental concern and (uncritically) reviews the federal response.

Juneja, Narendra. *Medford: Performance Requirements for the Maintenance of Social Values Represented by the Natural Environment of Medford Township, N.J.* Philadelphia: Center for Ecological Research in Planning, University of Pennsylvania, 1974. 64 pp. Available from Medford Township Office (Box 397, Medford, NJ 08055). $6.00.

Based on the McHarg approach this report distinguishes between social values and individual values provided by the natural environment. It argues that phenomena having value to society require action by the Township to ensure protection of areas which are: (1) inherently hazardous to human life and property, (2) hazardous to human life and health by specific human life and property, (3) irreplaceably unique and scarce resources, and (4) vulnerable resources where unregulated utilization will result in social costs. Regulations to sustain this social value can then be formulated as performance requirements for all human activities relating to that phenomenon; a proposed activity that meets the specified standard can be allowed to occur. The report goes on to specify performance standards related to flood and fire hazard, surface water, water table, nutrient absorption, drainage, historic resources, unique and scarce vegetation, habitats of rare and beneficial wildlife species, scenic resources, geologic resources, surface water management, groundwater and

runoff management, erosion management and vegetation management. The report recommends that the Town pass ordinances to implement it.

Kaiser, Edward J. et al. *Promoting Environmental Quality Through Urban Planning and Controls.* Washington, DC: U.S. Environmental Protection Agency, 1974. Paperback, 441 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $4.25 + 25% outside U.S.A.

A valuable reference that examines land use planning practice, formulates a "Land Use Guidance System Planning Process", looks at changing awareness and practice, and analyzes four promising approaches (land use planning for environmental control, water resource management, urban design, and planning and residuals management for noise and air quality).

Keyes, Dale. *Land Development and the Natural Environment: Estimating Impacts.* The Urban Institute (2100 M St. NW, Washington, DC 20037), 1976. Paperback, 128 pp. $4.95.

Part of a five-volume series (see Information Resources, 5.5 Environmental Impact Assessment), this volume discusses the evaluation of residential, commercial and industrial developments in terms of their natural-environment impacts (air quality, water quality and quantity, wildlife, vegetation and noise). It focuses on data requirements and the reliability of specific analytic techniques for estimating impacts.

Kitchen, Cameron, "Ecology and Urban Development: The Theory and Practice of Ecoplanning in Canada", in McBoyle, G.R. and Sommerville, E. (eds.). *Canada's Natural Environment: Essays in Applied Geography.* Toronto: Methuen, 1976. Paperback, 264 pp. $8.95.

Ecoplanning is an attempt to integrate an understanding of the physical and biological nature of the landscape into the management of the development process. It is expressed here as a "Developmental Sequence" in which ecological input is made at each step: 1. *site selection* (establishing selection criteria, locating suitable sites, selecting one); 2. *feasibility study, conceptual planning* (inventory of resource base, interpretation of resource data, integration of environmental considerations with other aspects of the study, formulation of conceptual plans); 3. *evaluation of alternative approaches* (determining relative merits or constraints of each alternative, approving the preferred one); 4. *master plan, functional design, site plan* (detailed site appraisal and evaluation, detailed environmental design, environmental management guidelines, master plan approval); 5. *implementation, construction* (site management to ensure management guidelines are followed); and 6. *monitoring the built environment.* The author examines the practice of ecoplanning in three case studies: a subdivision design in Kitchener, Ontario; the Metro Toronto Zoo project; and Highway 8 bypass at Cambridge, Ontario.

Kitchen, Cameron. *The Theory and Practice of Ecoplanning: The Port Aberdeen Recreation Community, A Case Study.* University of Glasgow, 1978. Contact the author at Ecoplans Ltd. (544 Conestogo Road W., Waterloo, Ont. N2L 4E2).

This Ph.D. dissertation is a detailed discussion of environmental planning and the requirements for integrating environmental information into planning and design decision-making. Part I presents a theoretical overview of the environmental planning process including ecological theory, data collection, planning and design theory, evaluation, and legislative and administrative requirements for environmental assessment in Ontario and in the United Kingtom. Part II details the environmental assessment activity (with emphasis on forest vegetation) associated with several stages in development of the site. The planning sequence extends from the early conceptual stage through to secondary subdivision and site plans. Information requirements of each stage are demonstrated. See also Case Study 71 (4.6 Recreation).

Krueckeberg, Donald A. and Silvers, Arthur L. *Urban Planning Analysis: Methods and Models.* New York: Wiley, 1974. Hardcover, 486 pp. $19.95.

A useful compendium of methods used by various kinds of planners. The methods described cover goal formulation, information gathering and analysis, decision models of choice and chance, sampling, identifying relationships among variables, evaluating and selecting programs, program scheduling, and a full range of models. A similar source is John W. Dickey and Thomas M. Watts, *Analytic Techniques in Urban and Regional Planning With Applications in Public Administration and Affairs* (New York: McGraw-Hill, 1978), hardcover, 542 pp., $24.00.

Lang, Reg and Armour, Audrey. *Municipal Planning and the Natural Environment.* Toronto: Ontario Planning Act Review Committee, 1977. Paperback, 90 pp. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $1.25, cheque payable to Treasurer of Ontario.

Annotated in 1.3 Characteristics of Environmental Planning.

Lang, Reg and Armour, Audrey. *Oakville Environmental Report: A Case Study in Environmental Planning.* Lang Armour Associates (22 Acacia Road, Toronto M4S 2K4), 1977. Paperback, 181 pp. $10.00.

Annotated in 2.7 Natural Environments and Human Activities. A "policy formulation and review process" is set out on pages 90-91.

Lash, Harry. *Planning in a Human Way.* Ministry of State for Urban Affairs (Ottawa K1A 0P6), 1976. Paperback, 96 pp. Free.

Describes the "Livable Region" planning approach of the Greater Vancouver Regional District. Annotated in 5.8 Public Participation.

Lassey, William R. *Planning in Rural Environments.* New York: McGraw-Hill, 1977. Hardcover, 257 pp. $17.95.

Annotated in 1.3 Characteristics of Environmental Planning.

Lichfield, Nathaniel et al. *Evaluation in the Planning Process.* New York: Permagon, 1975. Paperback, 325 pp. $12.95.

Annotated in 5.1 Environmental Planning in a Management Framework.

Mackintosh, E.E., "The Hanlon Creek Study: An Ecological Approach to Planning", in Krueger, Ralph R. and Mitchell, Bruce (eds.). *Managing Canada's Renewable Resources.* Toronto: Methuen, 1977. Paperback, 333 pp. $9.95.

Case study of the application of an ecological approach to planning for a developing area in Guelph, Ontario. See also University of Guelph, Centre for Resources Development, *Hanlon Creek Ecological Study,* 1972, annotated in 3.1 Streams and Valleys.

Marsh, William M. *Environmental Analysis for Land Use and Site Planning.* New York: McGraw-Hill, 1978. Hardcover, 292 pp. $22.50.

Annotated in 1.3 Characteristics of Environmental Planning.

McAllister, Donald M. (ed.). *Environment: A New Focus for Land Use Planning.* Washington, DC: National Science Foundation, 1973. Paperback, 328 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Catalogue No. N51.2:ENB, $3.75 + 25% outside U.S.A.

This book contains useful background material for environmental planning. See especially the papers by Cooper and Vlasen, "Ecological Concepts and Applications to Planning", and Croke, "An Evaluation of the Impact of Land Use on Environmental Quality".

McFarland, Margaret, "Land: A Nonrenewable Resource", *Practicing Planner* (American Institute of Planners), March 1978, pp. 44-47.

Describes Toledo-Lucas County's Land Use Allocation System which incorporates a resource management concept into local land use planning in a form adaptable to computer technology.

Melymuk, T. and Hughes, W. *Natural Environments in Ontario Municipal Planning: Progress and Prospects.* Ontario Ministry of the Environment (135 St. Clair Ave. W., Toronto M4V 1P5), November 1976.

Analyzes the environmental content of municipal Official Plans and related documents by means of six case studies: City of Guelph, City of Mississauga, Township of Nepean, Town of Oakville, City of Oshawa and the Regional Municipality of Waterloo. Builds on: Reg Lang and Audrey Armour, *Municipal Planning and the Natural Environment,* Ontario Planning Act Review Committee, 1977.

Municipality of Metropolitan Toronto. *Draft Plan for the Urban Structure.* The Municipality, Planning Dept. (City Hall, Toronto M5H 2N1), 1978. $5.00.

Policies include a "valley land impact zone", described in 3.1 Streams and Valleys.

Munson, Michael J., "Environmental Planning: Intraorganizational Aspects and Agency Effectiveness", *Growth and Change*, Jan. 1977, pp. 3-10.

Annotated in 5.1 Environmental Planning in a Management Framework.

Nassau-Suffolk Regional Planning Board. *Integration of Regional Land Use Planning and Coastal Zone Science.* The Board (H. Lee Donnison Office Bldg., Veteran's Memorial Highway, Hauppauge, NY 10022), 1976. Paperback, 307 pp.

Annotated in 3.4 Marine Coastal Zone.

Niagara Escarpment Commission. *Preliminary Proposals.* NEC (232 Guelph St., Georgetown, Ont. L7G 4B1), 1978.

The Niagara Escarpment is an outstanding natural feature that extends across southwestern Ontario from Tobermory to Niagara Falls. Increasing land use conflicts along the Escarpment, and its various resources and potential uses, led the provincial government to pass the Niagara Escarpment Planning and Development Act in 1973 "to provide for the maintenance of the Niagara Escarpment and land in its vicinity as a continuous natural environment, and to ensure only such development occurs as is compatible with that natural environment". The Act established the Niagara Escarpment Commission, defined a Planning Area and charged the Commission with preparation of a Plan that would protect unique ecologic and historic areas, maintain and improve the quality and character of natural streams and water supplies, provide adequate opportunities for outdoor recreation, maintain and improve the open character of the landscape as far as possible by such means as compatible farming and forestry and by preserving the natural scenery, ensure that all new development is compatible with the purpose of the Act, provide for adequate public access to the Niagara Escarpment, and help local municipalities discharge their planning functions. The Commission's Draft Plan was presented at public meetings in early 1978. It provoked much hostile reaction from landowners, causing the Province to reduce substantially the Planning Area. The Commission is now reconsidering the Proposals and preparing a draft plan. See also: Ian Reed, *Land In Demand: The Niagara Escarpment.* (Agincourt, Ont: Book Society of Canada Ltd., 1977), annotated in 3.6 Environmentally Sensitive Areas; and J.T. Horton, "The Niagara Escarpment: Planning for the Multi-Purpose Development of a Recreational Resource", in Ralph R. Krueger and Bruce Mitchell (eds.), *Managing Canada's Renewable Resources* (Toronto: Methuen, 1977), paperback, $9.95.

Ohio Dept. of Natural Resources, Division of Planning. *A New Approach to Land Use Planning in Ohio.* The Division (1952 Belcher Drive, Fountain Square, Columbus, OH 43224), Jan. 1973. 22 pp. Free.

This brief but useful report presents an alternate approach to "comprehensive" land-based planning "which has often been only partly related to the capability of the physical environment to accommodate the works of man" and which often did not have a logical or defensible basis. "Land Capability Planning treats the physical environment as a dynamic entity that cannot be used in disregard to the processes and interrelationship of man and nature". Such planning involves: (a) the relationship of man and nature, (b) the tenet that nature varies from place to place, and (c) the basic premise of suitability/capability of the land to accommodate human activity. The capability approach follows this *six-step procedure*: 1. define the geographic area of planning need; 2. inventory ecosystem/physical data (natural and cultural resources); 3. assign values to inventoried information (suitability criteria), expressing physical features and interrelationship ratings as suitability on maps; 4. project needed future land by use categories; 5. selectively analyze suitability-capability maps and synthesize findings to produce basic land use maps; and 6. use this map along with local goals/objectives, projected needs and capability of the study area to generate an overall comprehensive plan.

Ontario Ministry of Housing, North Pickering Development Corporation. *Environmental Management Opportunities and Constraints Within the North Pickering Site.* The Corporation (950 Yonge St., Toronto M7A 2K4), Aug. 1975. 83 pp.

Proposes strategies for guiding the management of physical site resources on the site of the Province's proposed new community northeast of Metro Toronto. The report sets out "planning parameters" (see Case Study 86) and "environmental quality goals" based on environmental principles of diversity, productivity, cyclicity and management. It then: provides an overview of resource surveys and future survey requirements; synthesizes the site's major environmental features; provides a regional overview of vegetation before and after new community development; spells out environmental management standards for wildlife habitat, fisheries, water quality and quantity, air, groundwater and setbacks; discusses environmental assessment of the plan for the new community; sets out proposals for environmental management (natural and man-made resources); details required planning and design; offers construction practice guidelines; proposes ongoing monitoring and a historical record of change; and examines cost and policy implications of environmental management.

P.E.I. Land Use Service Centre. *Concept Plan, Central North Shore, Prince Edward Island.* The Centre (Mackay Memorial Bldg., Grafton St., Charlottetown C1A 7N8), n.d., about 1977-78.

Problems of conflicting land use, emanating mainly from heavy recreation-tourism use adjoining the P.E.I. National Park, led the provincial government to initiate a one-year intensive citizen consultation process (Harold F. Verge, was the consultant) in an effort to mediate between federal, provincial, municipal and private groups and individuals making land-use decisions. The approach combined openness and environmental concern. It resulted in a plan intended to guide future preservation, conservation and development decisions affecting land use in the area.

Qu'Appelle Basin Study Board. *Report of the Qu'Appelle Basin Study Board.* Queen's Printer (Legislative Bldg., Regina, Sask.), 1972. 65 pp. $1.00. *Canada-Saskatchewan Subsidiary Agreement on the Qu'Appelle Valley.* Oct. 1975. *Qu'Appelle Information,* newsletter. Qu'Appelle Information Office (Fort Qu'Appelle, Sask. S0G 1S0, or P.O. Box 7110, Regina, Sask.)

In October 1975 the Governments of Saskatchewan and Canada signed a 10-year agreement calling for spending of $33.7 million to protect and improve the Qu'Appelle Valley environment and to develop its tourism and recreation industry. The Qu'Appelle Basin Study Board Report, above, formed much of the basis for the agreement. Land use planning and controls are a major component of the environmental management program for which considerable detailed documentation is available. See Case Study 95 in 5.6 Organizational Arrangements.

Red Deer Regional Planning Commission. *Sylvan Lake Management Plan.* The Commission (4920 – 59th St., P.O. Box 5002, Red Deer, Alta. T4N 5Y5), Feb. 1977. 23 pp. + maps.

One of a series of such plans being prepared by the Commission. Described in Case Study 42 (3.3 Lakes).

Rutgers University, Institute for Environmental Studies. *A Guide to the Environmental Aspects of the Local Planning Process.* N.J. Dept. of Community Affairs, Bureau of Local Management Services, Local Planning Assistance Unit (363 W. State St., Trenton, NJ 08625), 1976. Paperback, 196 pp. $3.00.

Annotated in 1.3 Characteristics of Environmental Planning.

Saskatchewan Environmental Advisory Council. *Land Use Policies in Saskatchewan.* Sask. Dept. of the Environment (1855 Victoria Ave., Regina S4P 3T1), June 1974.

This report concluded, "Land use planning and management in Saskatchewan, in the absence of an overall land use scheme, has become the responsibility of a host of government agencies and departments. Very real conflicts over land use patterns and priorities reflect this division of responsibility. In addition, there are agencies of government which are assigned tasks respecting conflicting land uses. Overall, no single agency is able to act as a powerful spokesman for land use and environmental concerns". A 1975 workshop to discuss the report called for a provincial land use policy. The government established a Land Use Policy

Committee in the Department of the Environment. The Committee has since issued a series of "Fact Sheets" to provide background information on land use and report progress on development of the land use policy. Community workshops were held at various centres (28 in February-April 1978) across the province.

Sargent, Frederic O. *Rural Environmental Planning.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), 1976. Paperback, 199 pp. $7.00.

Annotated in 1.3 Characteristics of Environmental Planning.

Schubenacadie-Stewiacke River Basin Board. *Interim Recommendations for Water Management in the Schubenacadie-Stewiacke River Basin.* Nova Scotia Dept. of the Environment (P.O. Box 2107, Halifax B3J 3B7), Dec. 1977. 32 pp.

The Schubenacadie-Stewiacke River Basin is part of the Halifax-Dartmouth region which is experiencing urban development pressure. As a result of a federal-provincial committee's review of water resource management problems, the two senior governments in 1976 began a River Basin Study to (a) examine critical problems affecting water resources in the Basin, (b) propose interim measures to control these problems and maintain future options, and (c) develop a comprehensive management framework that focuses on water quality/quantity and complementary development. This report documents progress on the Study administered by the Shubenacadie-Stewiacke River Basin Board comprising two officials from each of the senior governments. Planning for water-related concerns in the River Basin is closely linked to other planning efforts in the watershed including municipal and regional plans, recreation and conservation planning for the Amherst-Dartmouth corridor, and the Bay of Fundy Tidal Power Study (see 4.7 Energy Projects). Public involvement is an integral part of the study process. Interim recommendations focus on three sets of critical situations: waste treatment and water supply problems, stream bank erosion, and acid drainage from excavated or exposed bedrock in the river basin. The study approach is felt to be particularly appropriate for a region which has a pro-development bias and fears "environmental obstructionism", circumstances under which an environmental plan must have measurable economic utility. Once mismanagement of an environmental characteristic has been established as an important limiting factor to growth, the concept of environmental planning/ management may be more readily accepted. For further information contact Dr. R. Bailey, N.S. Department of the Environment.

Simonds, John O. *Earthscape: A Manual of Environmental Planning.* New York: McGraw-Hill, 1978. Hardcover, 340 pp. $24.95.

Annotated in 1.3 Characteristics of Environmental Planning.

Stanford Research Institute, Center for Study of Social Policy. *Handbook of Forecasting Techniques.* Fort Belvoir, VA: U.S. Army Corps of Engineers, Dec. 1975. Paperback, 314 pp. Available from National Technical Information Service (5285 Port Royal Rd, Springfield, VA 22161).

Designed to help planners improve their expertise in long-range forecasting. Twelve basic methods suitable for a wide range of technological, economic, sound and environmental forecasting are discussed and procedures for each are described with examples. An appendix lists approximately 150 forecasting techniques.

U.S. Environmental Protection Agency. *Guidelines for State and Areawide Water Quality Management Program Development.* U.S. E.P.A. (Washington, DC 20460), Nov. 1976. 334 pp.

Sets out in detail what is involved in the preparation and implementation of water quality management plans under Section 208 of the Federal Water Quality Pollution Control Act, 1972. Annotated further in 2.3 Water Quality.

Vietch, Ian. *Ecological Approaches to Land-Use Planning.* York University, Faculty of Environmental Studies (4700 Keele St., Downsview, Ont. M3J 2R2), Student Discussion Paper No. 7, June 1978. 74 pp. $1.00.

Describes ecological planning methods under seven categories: capability, suitability, environmentally sensitive area, environmental impact assessment, carrying capacity, performance requirements and miscellaneous approaches. Each is examined according to its ecological basis, dependent and independent variables, products, and interpretation of the natural environment for land-use interactions. Gaps in ecological knowledge are identified and promising directions are suggested by relating ecology to land planning and management.

Wallace, McHarg, Roberts and Todd. *Woodlands New Community. Land Planning and Design Principles.* 85 pp. *Ecological Inventories.* 85 pp. *Guidelines for Site Planning.* 61 pp. *Ecological Plan.* 78 pp. Woodlands Development Corporation (One Shell Plaza, Houston, Texas), n.d., about 1974. Available from W.M.R.T. (1737 Chestnut St., Philadelphia, PA 19103), $5.00 for each of the four volumes.

"By identifying and interpreting explicit natural phenomena which contribute to a balanced ecosystem, the planner is able to specify the most and least suitable land use for a particular landscape. Using this information, he is able to determine more accurately the consequences of alternative actions and he can also measure the degree to which compromises can be made when objectives are in conflict". The ecological planning process documented in these four reports aimed at: employing the latest scientific data to determine land planning and management recommendations; using these to discover the best environmental accommodation between land-use impacts and the physical characteristics and landscape tolerances of the site; relating environmental/social/economic programming data to a common base for decisions; and demonstrating that the ecological approach could exercise a positive physical, social and financial influence at all scales of planning and design of the new community. *The ecological planning process* involved: 1. inventory and mapping of ecological data; 2. interpretation of data; 3. determination of landscape tolerances based on the data; 4. determination of development intensities for various land uses; 5. establishment of a design synthesis; 6. matching of development intensities with landscape tolerance; 7. creation of land and site planning guidelines; and 8. preparation of a master land use plan responsive to environmental as well as social, economic and financial objectives. The proposed new community – 142 000 people on 18 000 acres – was subjected to an earlier environmental impact assessment (HUD funding was involved). See U.S. Dept. of Housing and Urban Development, *Final Environmental Statement, Proposed New Community of Woodlands, Montgomery County, Texas* (Washington: HUD, 1972); available from National Technical Information Service (5285 Port Royal Rd, Springfield, VA 22161), Feb. 1972, PB 204 498-F, $5.50.

5.5 Environmental Impact Assessment

Since the late sixties, environmental considerations have gained prominence in public and private decision-making. One response to these concerns, and a reason for their higher profile, is environmental impact assessment. EIA is a form of pre-action evaluation intended to determine whether to proceed with a given project and/or how to proceed so as to prevent or minimize environmental degradation. Before permits and approvals are given to build or expand facilities, to change processes or to implement new policies, proponents today may be required to conduct thorough assessments of the environmental implications of their proposed actions, expose these to public scrutiny and adopt measures to mitigate adverse effects.

Environmental impact assessment as explicit public policy first appeared in the U.S. National Environmental Policy Act of 1970. The Act set clear environmental goals for U.S. federal agencies and, as an action-forcing measure, required them to submit detailed environmental impact statements for actions that could significantly affect the human environment. For the first time federal planners and decision-makers were



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required to prepare public reports which disclosed: 1. the environmental impact of a proposed action; 2. unavoidable adverse environmental effects; 3. project alternatives; 4. the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity; and 5. any irreversible or irretrievable commitment of resources, should the action proceed.

Various legal and administrative requirements for EIA also found their way to Canada. At the federal level, a 1973 Cabinet directive established the Environmental Assessment and Review Process to ensure that all federal departments, Crown agencies, and private companies with government contracts, grants, and loans: 1. took environmental effects into account early in the planning of new federal projects, programs and activities; 2. carried out environmental assessment for all projects which might have an adverse effect on the environment, before commitments or irrevocable decisions were made, and submitted projects with potentially significant environmental effects to the Department of the Environment for review; and 3. used the results of these assessments in planning, decision-making and implementation. Nine provincial governments have also adopted some form of environmental impact assessment. Seven of the provinces use existing environmental protection legislation as the basis for requiring EIA, though often at the Minister's discretion. New Brunswick in 1975 elected to follow the federal example by taking an EIA policy and administrative approach. Ontario is the only province to enact a new law, the Environmental Assessment Act of 1975, that subjects designated public and private sector undertakings to environmental assessment before the provincial government gives its decision on the project's feasibility.

Refineries, pulp mills, pipelines, hydroelectric power projects, highways, dams and airports so far have been the main targets of formal environmental impact assessment in Canada. Size of project is a key factor determining whether EIA is required for a given project but the significance of its environmental effects and potential for political controversy are important too. Projects that have been assessed provide only a rough indication of what is likely to be assessed, however. Requirements vary across the country from jurisdiction to jurisdiction and often are not finalized.

Table 5.3 Provincial Approaches to Environmental Assessment, 1978

Province	Basis for Environmental Assessment		
	Use specific Act or regulations	Use other environmental legislation	Use EA policy or administrative procedure
British Columbia		●	●a
Alberta		●	
Saskatchewan		●	●b
Manitoba		●	●b
Ontario	●		
Quebec	●	●	
New Brunswick			●a
Nova Scotia		●	
Newfoundland	●c	●	●b

a for public projects

b underway

c being considered

British Columbia: The Environment and Land Use Act, 1971. Land Act, 1970. Pollution Control Act. Coal Mines Regulation Act, 1969. The Water Act, 1960. Guidelines for Environmental Impact Assessment of Power Projects. Coal Development Guidelines. Guidelines for Linear Developments. Guidelines for Environmental Impact. Control of Development on B.C. Crown Lands.

Alberta: The Land Surface and Reclamation Act, Chapter 34, 1973. Environmental Impact Assessment System Guidelines.

Saskatchewan: Department of the Environment Act, Chapter 31, 1972. Environmental Impact Assessment Policy and Guidelines.

Manitoba: Clean Environment Act, Chapter 130, 1972. Environmental Assessment and Review Policy.

Ontario: The Environmental Assessment Act, 1975. Environmental Assessment Guidelines.

Quebec: The Environmental Quality Act, Chapter 49, 1972, Regulations.

New Brunswick: Environmental Impact Assessment Policy, 1975.

Nova Scotia: The Environmental Protection Act, Chapter 6, 1973. The Water Act, Chapter 335, 1973. Guidelines for Environmental Assessment.

Prince Edward Island: Executive Council Minute 16/73, 1973.

Newfoundland: Approval in principle given to the drafting of an Environmental Assessment Act.

Three approaches are commonly used to determine what will be assessed:

1.*Specifying the activities that require environmental impact studies in legislation or regulations.* Manitoba's Clean Environment Act, for example, can be used to require environmental impact studies for "any industry, undertaking, plant or process that will or may result in the discharge or emission of any contaminant into the environment". Similarly, water and sewerage works are likely to receive environmental impact assessment under Newfoundland's Department of Provincial Affairs Act. In both cases application of the EIA requirement is limited to a few specific concerns. By contrast legislation in Quebec and Ontario covers a wide range of activities. Three sets of regulations have been drafted to implement Quebec's Environmental Quality Act: a general regulation which requires limited assessments for electric transmission lines, provincial railways and pipelines; regulations respecting quarries; and regulations respecting pulp and paper effluents and waste. A comprehensive environmental impact policy now being drafted is to include a list of the projects for which impact statements are mandatory in Quebec. Meanwhile, Ontario is devising regulations to implement its Environmental Assessment Act. All provincial undertakings require impact studies unless they have been specifically exempted (most are, unfortunately). Regulations have been drawn up but are not yet in effect to bring municipal projects under the Act. Eventually, private sector activities are to be designated for mandatory EISs; so far, three project-specific regulations have been prepared: Onakawana coal development, Reed Paper's proposal to log 49 000 km^2 in northwestern Ontario, and INCO's intended dam on the Spanish River.

2.*Determining the need for an environmental impact study on a case-by-case basis.* The federal Environmental Assessment and Review Process takes this route. Using the "rule of reason", government departments screen their projects and those they fund to see if significant environmental effects might result; environmental assessment is done only if the proponent department decides to subject to the E.A.R.P. (a fair amount of "persuasion" is involved). Alberta's Land Surface Conservation and Reclamation Act provides an apparently more rigorous example of the same approach. The province's Minister of the Environment can require and decide the scope of environmental assessments. Proponent departments must ask the Minister to clarify whether an Environmental Impact Report is required before they apply for permits, approval or licences. Criteria for screening projects form part of Alberta's Guidelines for an Environmental Impact Assessment System. Projects likely to require environmental assessment include those that adversely affect the natural environment directly or indirectly, represent small but significant triggering or precedent-setting actions, generate potential adverse cumulative effects, or are otherwise likely to be controversial.

3.*Special designations and voluntary assessments.* This approach is most likely to apply to controversial, large-scale projects not now required by legislation or administrative requirement to undergo environmental assessment. It provides a measure of discretion for provinces such as Ontario and Quebec which through regulations have determined in advance the need for an environmental assessment.

No Canadian jurisdiction requiring environmental impact assessment has a single set of criteria for an adequate EIA. Study guidelines for types of projects, such as pipelines and pulp and paper mills, exist at provincial and federal levels but these guidelines are often too general to be useful in drawing up specific terms of reference. The required scope of the study will vary for each assessment depending on the nature of the project, the environment affected, the jurisdictions involved and the degree of public controversy.

Stage	Focus	Concerns	Issues
Determining Need For EIS	When and how to apply EIS requirement	Known effects Uncertainty/unknowns/ risks Controversy Environmental condition Environmental goals/obj. cost	Who decides this Appropriate intervention point (stage of planning/ decision-making)
Study Design	Content and process of EIS	Use of EIS (information or decision-making) Criteria for evaluation Kind of information required Participants (who/role) Methods/techniques	Who should be involved, how, when Scope of the study (definition of environment and alternatives) Where in the decision process we're at
Identification	Likely effects	Causal factors (aspects of the project likely to induce environmental changes) Impact area (existing environmental condition, who and what may be affected, key concerns)	Tendency to stick to quantifiables Tendency to focus on direct effects Too much detail, not enough synthesis "Objective" vs "subjective" information, experts vs citizens
Prediction	How much and where	Forecasts of specific changes Quantity/quality/spatial dimensions Probability	Lack of baseline information Lack of predictive methods Uncertainty-protective strategies
Evaluation	Importance or significance of changes Translating *effects* (changes) into *impacts* (desirability of changes)	Costs and benefits Trade-offs among alternatives Differential distribution Mitigation potential	Sources for making evaluations Evaluation criteria and process Aggragation of effects/ synthesis Incommensurables
Presentation	Integrating and synthesizing information and findings	Selecting a framework for presenting complex information Clearly summarizing the EIS process (criteria for evaluation, process of evaluation, sources and judgments, nature of trade-offs made) Determining the strategic arguments	Too much detail, too little synthesis
Review of EIS	Adequacy of EIS Whether or not to proceed (significance and desirability of changes with and without the project) Conditions of approval	Gaps/omissions Misrepresentation Suitability and validity of methods Trade-offs Mitigation potential Implementation constraints	Decision rules Timing of process Fairness of the process
Decision (the black box)	Whether or not to proceed Conditions of approval	Political feasibility Implementation constraints Legal requirements Compensation	Decision rules Accountability
Monitoring and Review of Environmental Change	Actual changes and impacts Effectiveness of mitigation measures Adequacy of regulatory processes	Adherence to agreements Accuracy of EIS Adjustments required	What to monitor Who does this How Access to the data

Figure 5.9 Stages in Environmental Impact Assessment

Nine distinct stages characterize an environmental impact study. Each stage in the process has its own particular focus, set of concerns, and issues or problems, as indicated by Figure 5.9. A typical environmental impact report, the most visible product of this process, could be expected to provide the following information:

a. *Project description*: a discussion of the need for the project, what it will involve, alternatives to it and staging.

b. *Environmental inventory*: a description of the key aspects of the natural and human environments likely to be affected by the project, including an evaluation of the current condition as a base from which to determine the relative importance of expected changes.

c. *Identification and prediction of environmental effects*: bringing together (a) and (b) to determine possible environmental changes, both primary and secondary, in the immediate area and beyond; and forecasting the location, extent and probability of expected effects.

d. *Mitigating actions*: determination and assessment of measures necessary to prevent or reduce the severity of environmental effects identified under (c). This may include a description of adverse effects that cannot be avoided, particularly if these have serious implications.

e. *Evaluation*: determination of who benefits and who pays and the importance of the expected environmental effects; identification of tradeoffs and risks involved should the proposed action or an alternative be implemented.

f. *Study process*: a discussion of the methods used, limitations of the study, criteria applied in determining the significance of environmental effects, and interests consulted during the study.

Although the foregoing framework can be said to constitute the "method of" environmental impact assessment, there is no universally accepted procedure or "cookbook approach" to individual impact studies. Techniques can be classified in terms of their applicability to the identification, prediction and evaluation stages of the impact study process:

Identification	Checklists, of four kinds: simple list of parameters, descriptive list which includes parameter measures, scaled checklist which evaluates importance of parameters given project type, and weighted checklist which ranks parameters (see Planning Environmental International). Matrices (an early example is Leopold's). Networks or stepped matrices (see Sorensen). Cross-impact matrices (e.g. Ross). Map overlays. Opinion surveys, public meetings, etc. and other participative techniques.
Prediction	Trend extrapolation. Delphi. Metaphors, analogies and simulations. Scenario writing. Modelling.
Evaluation	Subjective evaluations of impacts. Ranking procedures for alternatives within each impact category. Weighting procedures (two examples are Battelle's Environmental Evaluation System and Odum's Totality Indices). Tradeoff analysis. Risk assessment.

Each stage has its own set of unresolved methodological issues. For example, impact identification procedures tend to favour the selection of quantifiable impacts, to focus more on direct effects (such as erosion or employment generated) than on consequences, and to overdo the level of detail required at the expense of other parts of the study. Prediction is probably the weakest stage; often lacking is the necessary information, especially time-series, and applicable techniques. Evaluation, however, presents the most difficult problems, in particular, selecting evaluation criteria, aggregating or summing effects, and ranking/weighting effects.

Devising a specific study approach involves careful consideration of appropriate methods and techniques alongside the nature of the given environment/ activity combination. Factors to be taken into account include:

Purpose of the impact study. Is the EIA merely for information (revealing the implications of a proposed action) or is it for decision purposes (providing a basis for selecting among alternative courses of action)?

Significance of the issues. What range of issues are associated with the project proposal? How controversial are they?

Kinds of alternatives. Are the alternatives similar in kind (allowing direct comparisons among them) or do they differ fundamentally (raising issues of incommensurability)?

Familiarity. To what extent do team members have a working knowledge of the proposed activity, its effects and the receiving environment?

Resources and administrative/organizational constraints. For example, how much time, skills, money, knowledge, data and data-processing facilities will be available? Will the choice of study approach be constrained by specific agency policies or guidelines?

Formal requirements for environmental impact studies provide only one indicator of the extent of impact assessment activity. A lower-profile but in the long term probably more significant approach to impact assessment is evident in some sectors of professional planning and resource management practice. Here, the assessment and resolution of adverse environmental effects associated with planned actions have become integral parts of the planning process. Impacts are taken into consideration, not by doing discrete one-point-in-time impact studies, but in an iterative environmental assessment *process* corresponding to the various planning and design stages of project development. Current examples of this approach include Ontario's Townsend New Town Environmental Plan (Ecoplans Ltd., 544 Conestogo Road W., Waterloo, Ont. N2L 4E2); North Pickering New Town (North Pickering Project, 950 Yonge Street, 6th Floor, Toronto M7A 2K4); Toronto Central Waterfront Study (Central Waterfront Planning Committee, 235 Queen's Way W., Toronto M5J 1A6); B.C.'s Northeast Coal Study (Environment and Land Use Sub-Committee on Northeast Coal Development (E.L.U.C. Secretariat, Parliament Buildings, Victoria V8V 1X4); and the Sanibel Environmental Plan (see 5.4 Plans).

The challenge is to ensure that the concerns and approaches of environmental impact assessment penetrate not only project planning processes but, more broadly, the more comprehensive planning management processes that determine whether specific projects are required, where and when they will locate, and how they interrelate within larger systems.

Case Study 90
Donohue St-Félicien:
EIA of a Kraft Pulp Mill
Submitted by
Beak Consultants Ltd.

Located in the Lac St. Jean area of Quebec, St-Felicien is a town of about 4 000 with high unemployment, out-migration and limited industry. The combined BCFP/Donohue kraft pulp mill, funded through the federal Department of Regional Economic Expansion and provincial grants, was intended to provide economic support for the area. Environmental impact of the project was a significant concern, however, since the receiving waters of Lac St. Jean are a major salmon spawning and recreation area.

The EIA study process was complicated by three factors: the mill was partly built when the EIA regulation was applied; it was the Province's first impact assessment; and the government changed, from Liberal to the Parti Quebecois, in mid-study. The terms of reference for the impact study emphasized existing water quality, flows and salmon migration patterns, assimilative capacity, waste treatment requirements, and alternative effluent disposal methods (dump it in the nearby river vs. pipe it 32 km to the lake). The study indicated no salmon behavioural aversion, toxicity or water quality problems with as little as 50% diluting. Since salmon spawn upstream it was decided to test actual effluent/fish interaction for a year or so before final approval is given to the outfall. The impact assessment report covered engineering, terrestrial, air quality and socio-economic as well as aquatic parameters. It was made publicly available and a series of public meetings followed.

Refer to:
Les Conseiller Beak Ltée., *Répercussions Environnementales Fabriquées de Pâte Kraft Donohue St-Félicien*, Montréal, Donohue St-Félicien, 1977.

W. Eedy and K. Schiefer, "Donohue St-Félicien Environmental Impact Study: Innovative Technology Allows More Accurate Prediction", *Canadian Pulp and Paper Industry* 30 (16), 1977. pp. 14-16.

W. Eedy and K. Schiefer, *Environmental Impact Assessment of the Donohue St-Félicien Kraft Mill in Québec: A Relevant Case Study for the Pulp and Paper Industry*, Preprints, CPPA Environmental Improvement Conference, Moncton, November, 1977.

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Case Study 91
EIA of the Proposed Relocation of Highway 7 from Welsford to Saint John
Submitted by Nancy McInnis, Environment New Brunswick

Route No. 7 is a two-lane highway connecting the cities of Fredericton and Saint John in the southern part of New Brunswick. The lower section from Welsford to Saint John, highly congested due in part to the rapid growth of ajoining "bedroom communities", is also the primary truck route from the industrial centre of Saint John. Increased highway safety problems and reduced capacity to accommodate peak traffic flows led to a proposal to relocate that part of the highway.

Large-scale government proposals such as the relocation of Route No. 7 are subject to the New Brunswick Environmental Impact Assessment Policy which came into effect in October 1975. The policy requires that, before a decision is made to proceed with any government funded project considered to have potential to cause significant impacts on the environment, a study must be undertaken to identify the project's environmental consequences.

The EIA process for Route No. 7 enabled local communities to influence the location of the preferred route so as to protect agricultural lands and minimize many potential environmental impacts. For the proponent, areas of conflict requiring further study before proceeding were clearly identified and an acceptable route was chosen. Overall, the public participation process and the interest of local residents were the main factors contributing to the study's effectiveness.

The completed document was reviewed by the provincial Department of the Environment, other government agencies and the public. The results of this review were then presented to the appropriate government body for a decision on whether to proceed with the project.

Refer to:
New Brunswick Department of Transportation, Planning Branch, *Environmental Overview of Corridor and Route Alternatives. Volume 1*, Fredericton, September 1977.

Contact:
New Brunswick Department of the Environment
P.O. Box 6000
Fredericton, N.B. E3B 5H1

Case Study 92
Little Cataraqui Creek, Kingston, EIA
Submitted by Fred Curtis, Queen's University

The Little Cataraqui Creek is one of two watercourse/marsh ecosystems in Kingston, Ontario. Until 1975 the stream valley, relatively free of development, was used for recreational activities and nature studies. Since 1975 however, a land use conflict has arisen between those who want the valley to be zoned as green belt or open space and developers who propose commercial and residential uses for the area.

The Little Cataraqui Environmental Impact Assessment was intended to identify and evaluate the environmental effects of several development scenarios along one reach of the Creek on Kingston's western boundary, and to assist the determination of equitable, practical and desirable land uses for the Creek Valley. The study involved three work phases: 1. identification, using environmental indicators, of the Creek's significant biophysical, socio-economic and cultural characteristics; 2. description of four development scenarios (including the no-build alternative) specifying types and arrangements of land use; and 3. identification and evaluation of

the potential effects associated with the development activities of each scenario, using a matrix to summarize and depict the degree of potential impact.

Some development could proceed in the area, the study determined, but a large part of the Creek should remain undeveloped. Scenarios were ranked in terms of potential impact and one was recommended to the City. Also proposed were a number of environmental planning goals that took into consideration not only the future of the Little Cataraqui Creek watershed but also the Kingston waterfront and the nearby Great Cataraqui River.

The City subsequently purchased 32 acres of land, including 13 acres of floodplain, at a cost of $500 000. An additional 22 acres were acquired for parkland on a cost-sharing basis by the Conservation Authority ($61 000), the Little Cataraqui Environment Association ($20 000) and the City ($19 000). The City expects to recover its investment through the sale of a parcel in the southern part of the 32 acres to a local developer who plans to build a six-storey 160-unit apartment. The northern two-thirds of the 32 acres is to remain undeveloped; the hope is that it may be purchased and maintained by the Conservation Authority.

Refer to:
F.A. Curtis and S. Noakes (eds.), *Little Cataraqui Creek: An Environmental Impact Assessment Report*, Queen's University, School of Urban and Regional Planning, 1976, 304 pp.
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Case Study 93
Environmental Impact Assessment and Municipal Planning

Applying environmental impact assessment requirements to the municipal planning context presents a number of difficult issues: how to minimize potential conflicts and delay created by two overlapping public hearing processes; how much scope to give to municipal EIA (should it apply only to municipal public works projects or should it extend to the official/general plan, zoning and plan amendments as well as municipally approved private sector projects?); how much municipal control to allow in the EIA decision-making process; and how to relate plan preparation and impact studies.

California and New York are two U.S. frontrunners in devising municipal EIA requirements. Local governments in California are required to prepare impact reports on locally initiated public works projects, locally approved private sector projects, general (municipal development) plans and their amendments, and zoning by-laws. New York's requirement, less stringent, applies only to projects directly undertaken by the municipal government (see Information Resources). The California experience is documented in: R. Catalano, and R. Reich, "Local Government and the Environmental Impact Assessment Process", *American Bar Association Urban Lawyer*; Ralph A. Catalano, *General Plans and EIRs: Complementary or Redundant?* (University of California, Program of Social Ecology, Irvine CA), about 1977; and Arthur W. Jokela, *Self-Regulation of Environmental Quality: Impact Analysis in California Local Government* (Center for California Public Affairs, 226 W. Foothill Blvd., Claremont, CA 91711), 1975. New York's requirement and guidelines are set out in *Handbook for Local Government* (New York State Department of Environmental Conservation, 50 Wolf Road, Albany, NY 12233), Oct. 1977.

Canadian experience in municipal environmental impact assessment processes is quite limited. The City of Winnipeg in 1972 became the first Canadian municipality to adopt a legal requirement for impact studies of public projects; the approach being taken has been considerably scaled down, however, as a result of a number of legal challenges and internal problems. The Province of Ontario is currently preparing regulations which will bring municipal projects under the 1975 Environmental Assessment Act. Some Ontario municipalities – the Regional Municipality of Waterloo and the City of Mississauga, for example – are already using the EIA approach (see 5.4 Plans). Ontario's proposed regulations are contained in *The Environmental Assessment Act and Municipalities* (Ministry of the Environment, Environmental Approvals Branch, 135 St. Clair W., Toronto M4V 1P5), October 1977, and *EA Update*, Vol. 3, No. 4, June 1978 (available from the Environmental Approvals Branch, Ministry of the Envi-

ronment). For a discussion of environmental impact assessment in Canada from a legal perspective, including a discussion of municipal approaches especially in Ontario and Manitoba, see D. Paul Emond, *Environmental Assessment Law in Canada* (Toronto: Emond-Montgomery Ltd., 1978), annotated in Information Resources.

Information Resources

See also:
5.7 Regulation and Review

Alberta Culture. *Interim Guidelines. Historical Resources Impact Assessments.* Alberta Culture, Historical Resources Division (419 Beaver House, 10158-103 St., Edmonton T5J 0X6), March 1977.

Armour, Audrey and Lang, Reg. *Provincial Approaches to Environmental Assessment.* York University, Faculty of Environmental Studies (4700 Keele St., Downsview, Ont. M3J 2R2), June 1976.

The report summarized, for each province and the Northwest Territories: the key legislation under which environmental assessment was being carried out at that time; the organizational structure and progress towards guidelines and procedures; what kinds of activities were subject to environmental assessment; provisions for public participation; available examples of environmental impact studies done; and names, addresses and phone numbers of persons and agencies to contact. See also: B.C., Ministry of the Environment; and Canadian Council of Resource and Environment Ministers.

Association of Consulting Engineers of Canada. *Environment 1, A Workshop on Environmental Impact Assessment.* The Association (130 Albert St., Suite 616, Ottawa K1P 5G4), 1975. $10.00.

Representatives from the federal government and each of the provinces presented papers discussing their approach to and perspectives on environmental impact assessment.

Berger, Mr. Justice Thomas R. *Northern Frontier Northern Homeland. The Report of the Mackenzie Valley Pipeline Inquiry.* Ottawa: Minister of Indian Affairs and Northern Development, 1977. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), Vol. 1 and 2, $5.00 each ($6.00 outside Canada).

Volume 1 of this historic document deals with the social, economic and environmental impacts of the proposed Mackenzie Valley pipeline and energy corridor. Volume 2 sets out necessary terms and conditions, should the pipeline be built.

Blissett, Marian (ed.). *Environmental Impact Assessment.* Engineering Foundation (345 East 47 St., New York, NY 10017), 1976. Hardcover, 278 pp. (Copy obtained from Program Manager, Division of Intergovernmental Science and Public Technology, National Science Foundation, 1800 G St. NW, Washington, DC 20550).

See Part Three, "Techniques for Evaluating Environmental Impacts". Technology assessment, matrix techniques, and totality indices are the main approaches covered.

British Columbia, Environment and Land Use Committee. *Guidelines for Linear Development.* The Committee (Parliament Buildings, Victoria V8V 1X4). March 1977. 32 pp.

Outlines a planning process designed for the management of land use and assessment of the environmental and social impacts of linear developments such as railways, pipelines, transmission lines, highways and industrial roads. Annotated further in 5.7 Regulation and Review.

British Columbia. Ministry of the Environment. *Environmental Impact Assessments in Canada.* The Ministry (Parliament Buildings, Victoria V8V 1X4), February 1977. 33 pp.

A review of current legislation, prepared for the Canadian Council of Resource and Environment Ministers.

Canadian Council of Resource and Environment Ministers, Environmental Impact Assessment Task Force. *Canadian Environmental Impact Assessment Processes.* CCREM (60 Bloor Street West, Suite 701, Toronto M4W 3B8), 1978. 34 pp. $2.00.

Prepared for the CCREM 1978 Annual Meeting this report examines Canadian approaches to EIA focusing on six current procedural issues: types of projects requiring impact assessment, the scale of projects requiring EIA, timing of the EIA process, degree of flexibility in applying the process, key actors and their roles, and extent of citizen participation. Concluding that a common approach to EIA in Canada is neither desirable nor possible, the task force examined the legal framework and opportunities for cooperation between governments. The report ends with a set of recommendations intended to refine and improve EIA in Canada.

Canter, Larry. *Environmental Impact Assessment.* New York: McGraw-Hill, 1977. Hardcover, 331 pp. $21.60.

An introductory text on environmental impact assessment. Beginning with a brief history of the U.S. National Environmental Policy Act, Canter suggests a framework for impact analysis and assessment and then examines approaches to prediction and assessment of impacts in air quality, water resources, noise, biological environments, cultural environments and socio-economic environments. Chapter 10 provides a thorough review of methods of impact analysis.

Clark, B.D. et al. *Assessment of Major Industrial Applications, A Manual.* Aberdeen, Scotland: University of Aberdeen, Project Appraisal for Development Control Research Team, 1976. Available from Scottish Development Dept. (New St., Andrews House, Edinburgh, Scotland). 170 pp. £2.

This manual is intended to assist planners to make a balanced assessment of major industrial applications by providing a guide to the identification and description of the impacts of major developments. Chapter 1 outlines the background of the research, Chapter 2 sets out the proposed method of assessment; Chapter 3 discusses the relationship of the method to the planning system; and Chapter 4 describes the method in detail. There are five Appendices including 10 Technical Advice Notes which set out the background to the assessment of particular types of impacts (noise, water pollution, ecological impacts) and in some cases suggest techniques which can be used to measure the scale of effects that a major development may have. The Aberdeen University Project Team is now engaged in a "Study of the Relationships Between Development Appraisals and Development Plans". The team will examine plans, studies and impact analysis that have been completed or are in progress; analyze the main stages of both plan preparation and development appraisal; and recommend procedural modifications. Contact: Project Appraisal for Development Control, Dept. of Geography, University of Aberdeen (Old Aberdeen, AB9 2UF, Scotland).

Cluff Lake Board of Inquiry. *Cluff Lake Board of Inquiry Report, Justice F.O. Bayda, Chairman.* Saskatchewan Department of the Environment (Public Information and Education Branch, 1855 Victoria Ave., Regina), July 1978. 2 volumes. 1050 pp.

The Saskatchewan government established this Board of Inquiry in 1977 to investigate a $130 million uranium mine and mill project proposed at Cluff Lake. The report recommends that the uranium industry be allowed to expand provided that it conforms to strict new environmental, occupational and safety regulations.

Corwin, Ruthann et al. *Environmental Impact Assessment.* San Francisco: Freeman, Cooper & Co., 1975. Hardcover, 277 pp. $13.75.

Particularly useful source dealing with the origin, operation and outlook of EIA; social and economic impacts; Warm Springs Dam, a case study of social and economic impacts; the law of EIA; how to prepare an EIS; and tools for EIA.

Curtis, F. et al. *A Handbook for Environmental Assessment of Waterfront Related Projects.* Queen's University, School of Urban and Regional Planning (D504 Mackintosh-Corry Hall, Kingston, Ont. K7L 3N6), in progress 1978.

The handbook consist of three manuals: 1. evaluation of existing methods and their application to assessing the environmental effects of waterfront development activities; 2. procedure for impact identification, prediction and evaluation including techniques and data sources; and 3. considerations for evaluating the completeness and accuracy of EIAs.

Dee, Norbert et al. *Final Report on Environmental Evaluation System for Water Resource Planning.* Columbus, OH: Battelle Columbus Laboratories, 1972. 188 pp. Available from National Technical Information Service (5285 Port Royal Rd, Springfield, VA 22161), PB-208-822.

The Battelle approach to EIA is similar to the University of Georgia Institute of Ecology method (annotated under Odum). The procedure involves quantifying 78 environmental values and transforming them into commensurate units. The first step in the process weighs 78 parameters by determining their relative importance and then distributing 1 000 points among them. In the second step, all of the parameter values are transformed into commensurate units. An environmental quality function ranging from 0 to 1 is developed for each parameter to describe potential as well as present quality. The final step involves calculating the environmental impact with and without the project by determining the change in environmental quality for each parameter. To obtain an aggregated score for each alternative, the change in environmental quality for each parameter is multiplied by the weight given to the parameter and the 78 scores are totalled. For a summary statement see: "An Environmental Evaluation System for Water Resource Planning", *Water Resources Research* Vol. 9 No. 3, June 1973. Refer also to Ira L. Whitman et al., *Design of an Environmental Evaluation System*, 1971 (annotated in 4.4 Resource Development).

Dickert, Thomas G., "Approaches to Environmental Impact Assessment", *DMG-DRS Journal*, Vol. 9, No. 1, Jan./Mar. 1975, pp. 10-15.

Overviews the three basic analytical operations in EIA – identification, prediction and evaluation – and suggests common problems in both the conceptual formulation of procedures and their application in an impact study.

Dickert, Thomas G. and Domeny, Katherine R. *Environmental Impact Assessment: Guidelines and Commentary.* University of California, University Extension (2223 Fulton Street, Berkeley, CA 94720), 1974. 238 pp. $7.50 (payable to the Regents of California).

An early but still relevant publication on EIA. Includes ten papers plus appendices on: linking the EIS to the planning process; NEPA/CEQA legal aspects; use of data in environmental impact assessment; some suggestions on the content and organization of environmental impact statements; social equity and environmental quality; the BART Residential Impact Study: an empirical study of environmental impact; concepts and methods of benefit-cost analysis; a case study of uncertainty and the evaluation of environmental impacts; the Berkeley Environmental Simulation Project and its use in environmental impact assessment; and comparison of EIA methods.

Duffy, P.J.B. *The Development and Practice of Environmental Impact Assessment Concepts in Canada.* Environment Canada (Ottawa K1A 0H3), Planning Occasional Paper #4, 1975. 18 pp.

Ecological Sub-Committee, Vancouver International Airport Planning Committee. *An Environmental Impact Assessment of the Vancouver International Airport Expansion: A Summary Report.* Environment Canada, Lands Directorate, Environmental Management Service (1001 West Pender St., Vancouver V6E 2H7), 1976.

Annotated in 3.4 Marine Coastal Zone.

Emond, D. Paul. *Environmental Assessment Law in Canada.* Emond-Montgomery Ltd. (56 The Esplanade, Suite 208, Toronto M5E 1A7), 1978. Hardcover, 360 pp. $30.00 plus $1.50 postage and handling.

The first book to deal solely with the legal aspects of EIA in Canada. Chapters discuss perspectives and options for environmental assessment law; the Ontario Environmental Assessment Act and how it is supposed to work; the Ontario Environmental Assessment Board; municipal environmental assessments in Manitoba and Ontario (with a case study of the Bruce-to-Milton transmission line, subtitled "A Case Study in Shoddy Decision-Making"); and the Federal Environmental Assessment and Review Process.

Environmental Assessment Panel. *A Guide to the Federal Environmental Assessment and Review Process.* Ottawa: Environment Canada, Federal Environmental Assessment Review Office, February 1977. Available from Environment Canada, Information Services Directorate (Ottawa K1A 0H3). Free.

A short brochure describing the federal E.A.R.P. See also: *Guidelines for Preparing Initial Environmental Evaluations*, issued by the Office of the Chairman, Environmental Assessment Panel (Environment Canada, Ottawa K1A 0H3), October 1976; *Register of Panel Projects and Bulletins*, Federal Environmental Assessment Review Office, 1978; and *Guide for Environmental Screening*, 1978, 156 pp., which outlines a systematic procedure for screening a broad range of projects so as to identify adverse environmental effects.

Environmental Assessment Panel. *Bay of Fundy Tidal Power Project. Draft Guidelines for the Preparation of an Environmental Impact Statement.* Environment Canada, Federal Environment and Assessment Review Office (Ottawa K1A 0H3), April 1978.

Annotated in 4.7 Energy Projects.

Environmental Assessment Panel. *Report of the Environmental Assessment Panel on Eldorado Uranium Refinery, Port Granby, Ontario.* Environment Canada, Federal Environmental Assessment Review Office (Ottawa K1A 0H3), 1978. 56 pp. Free.

This report is the Panel's conclusion on a proposal by Eldorado Nuclear Limited to construct a uranium hexafluoride refinery and waste management facility at Port Granby, Ontario. The Panel

found the proposed waste management system and other features of the proposed site unacceptable and rejected the Port Grandby site. The Minister of the Environment concurred. Eldorado then selected three alternate sites, prepared EISs and submitted the project for further review by the Panel whose report is due in early 1979.

Environmental Assessment Panel. *Shakwak Highway Project.* Federal Environmental Assessment Review Office (1870-1050 West Pender Street, Vancouver V6E 3J7; also available from Federal Environmental Review Office, Ottawa, K1A 0H3), June 1978, 60 pp.

Annotated in 4.5 Transportation.

Estrin, David and Swaigen, John. *Environment on Trial: A Handbook of Ontario Environmental Law.* Canadian Environmental Law Research Foundation. (1 Spadina Crescent, Suite 303, Toronto M5S 2J5), Revised Edition, edited by Mary Anne Carswell and John Swaigen, 1978. Paperback, 587 pp. $6.95.

A useful handbook for planners, lawyers, citizens and teachers. The book gives detailed summaries of laws relevant to environmental issues and discusses the Federal Environmental Assessment and Review Process. Pollution, from noise to oil spills and nuclear disasters, is examined as well as such topics as land use planning, solar energy, wilderness conservation, government agencies, and where to obtain information. Case studies illustrate the effectiveness of environmental regulations and management procedures. Annotated further in 5.7 Regulation and Review.

Finsterbusch, Kurt and Wolf, C.P. (eds.). *Methodology of Social Impact Assessment.* Stroudsburg, PA: Dowden, Hutchinson & Ross, 1977. Hardcover, 307 pp. $20.50.

35 papers cover social impact assessment and public policy, methodological approaches, profiling, projecting, assessment and evaluation.

Fischer, David W., and Davies, Gordon S., "An Approach to Assessing Environmental Impacts", *Journal of Environmental Management,* Vol. 1, 1973, pp. 207-227.

Concerned with incorporating EIA into resource management decisions. The assessment approach suggested consists of four steps: 1. identification of planned and induced activities; 2. identification of relevant elements of the environment likely to be affected; 3. evaluation of initial and subsequent impacts; and 4. management of beneficial and adverse environmental impacts. Discusses the use of three environmental matrices: environmental baseline evaluation matrix, environmental compatibility matrix and decision matrix.

Gibson, D., "Constitutional Jurisdiction Over Environmental Management in Canada", *University of Toronto Law Journal,* Vol. 23, 1973, pp. 54-87.

Herr, Philip et al. *Evaluating Environmental Impacts.* Massachusetts Institute of Technology, Laboratory of Architecture and Planning, Environmental Impact Assessment Project (Room 4-209, Cambridge, MA 02139), May 1978. 165 pp. $6.50.

A "guidebook" for local governments analyzing impacts of development proposals of community-wide significance. It provides a general approach to impact analysis, suggests methods and points out key issues for a range of impact categories (traffic, public facilities, fiscal, economic, social and visual impacts), and provides background information. Emphasis is on the Massachusetts context (although the principles and methods described have general applicability), small communities (fewer than 50 000 people), first-cut methods for use by laypersons, specific development proposals rather than long-range community-wide comprehensive plans, local rather than regional or state impacts, and the local level generally.

Information Resources Press (2100 M. St. NW, Suite 316, Washington, DC 20037).

Publishes abstracts of impacts statements which cover five aspects: purpose of the projects assessed; positive impact and mitigating action; negative impact; alternatives considered; and primary assessment considerations and/or methods. The annual *EIS Cumulative* costs $162 (non U.S.A.). Subscriptions to *EIS: Key to Environmental Impact Statements* are $265 per year (12 issues plus annual cumulative index). Microfilms of the statements can be ordered for $6.00 (for an EIS of about 490 pages).

Jain, R.K. et al. *Procedures for Reviewing Environmental Impact Assessments and Statements for Construction Projects.* Construction Engineering Research Laboratory, U.S. Army Corps of Engineers (P.O. Box 4005, Champaign, IL 61820), August 1975. 24 pp.

This report proposes classifying projects as high, medium or low impact and provides three sets of criteria for reviewing accuracy and completeness of an environmental assessment in each impact class. Its chief interest is in tailoring requirements for environmental impact assessments to the impacts of construction rather than the impacts of the final product.

Keyes, Dale L. *Land Development and the Natural Environment: Estimating Impacts.* The Urban Institute (2100 M Street NW, Washington, DC 20006), 1976. Paperback, 128 pp. $4.95.

This report is the third of five, produced by the Urban Institute, that discusses the evaluation of land developments in terms of their economic, environmental and social impacts. Keyes deals with natural environment impacts (air quality, water quality and quantity, wildlife, vegetation, and noise) of residential, commercial and industrial development. The focus is on data requirements and reliability of specific analytical techniques for estimating impacts. The first report in the series, *Measuring the Impact of Development: An Initial Approach* ($2.95) established a preliminary framework for evaluation and set out a series of measures for estimating impacts. The second report was *Fiscal Impacts of Land Development* ($2.95). The third covered *Economic Impacts of Land Development: Employment, Housing and Property Values* ($3.95). The fourth report was *Social Impacts of Land Development* ($3.95). Completing the series is *Using an Impact Measurement System for Evaluating Land Developments* ($3.95) which re-examines the overall framework of the first report and discusses the main problems and prospects of an impact measurement system.

Lagacé, Michel. *Evaluation d'impact potentiel du projet de construction d'une station de pompage, Ville de Grande-Rivière, Comté de Gaspé.* Ministère du tourisme, de la chasse et de la pêche, Direction de la recherche faunique, Groupe de recherche d'impact sur la faune (9530 rue de la Faune, Orsainville, Qué. G1G 5E5), mars 1978. 17 pp.

An environmental assessment of a water pumping station with special reference to salmon migration.

Lang, Reg and Armour, Audrey. *Information Resources for Environmental Impact Assessment.* Fourth Edition, 1978. Available from Lang Armour Associates (22 Acacia Road, Toronto M4S 2K4).

An extensive annotated bibliography on EIA legal/administrative requirements and guidelines, general methods and project-specific approaches (airports, highways, sewerage projects, housing, etc.) and case studies.

Lang, Reg and Armour, Audrey. *Urban Environmental Assessment in Canada and the United States.* York University, Faculty of Environmental Studies (4700 Keele Street, Downsview, Ont. M3J 2R2), June 1976. 160 pp. Unpublished.

A comprehensive overview (funded in part by the Ministry of State for Urban Affairs) of current legislation and administrative procedures for environmental assessment. Emphasis is given to the application and implications of EIA requirements in the municipal and urban context. Six examples of municipally initiated environmental impact reviews were examined (Regional Municipality of Waterloo, Ontario; San Diego, California; Boulder, Colorado; Duxbury, Massachusetts; Inglewood, California; and Winnipeg, Manitoba). Taken together, the studies reveal the "leading edge" (at this time) in the art of municipal impact review. The report ends with a detailed discussion of the issues and problems of urban environmental management and the role of EIA in that process. Ten appendices provide further information on EIA in Canada and the United States.

Leopold, Luna B. et al. *A Procedure for Evaluating Environmental Impact.* U.S. Department of Interior (Geological Survey, Reston VA 22092), Circular 645, 1971.

One of the earliest EIA methods, now somewhat outdated. The Leopold matrix consists of 100 specified actions and 88 environmental elements resulting in 8 800

possible impacts. In using the Leopold matrix each action and environmental element is considered. Where an environmental change is anticipated the matrix is marked with a diagonal line in the interaction box. The next step is to determine whether this is a key area of concern by assigning a value for the *magnitude* of the interaction (measured on a scale of 1-low to 10-high) and a value for its *importance*. Magnitude is usually an objective evaluation; importance is a subjective judgement by team members.

Lucas, A.R. and Peterson, E.B. *Northern Land Use Law and Policy Development: 1972-1978 and the Future.* Paper presented at the Canadian Arctic Resources Committee (46 Elgin St., Ottawa K1P 5K6) Second National Workshop, Edmonton February 20, 1978. 99 pp.

Although, the paper is oriented to North of 60°, it provides an interesting discussion of impact assessment procedures and guidelines in general (specifically E.A.R.P.), as well as a look at public inquiries such as that conducted by Berger.

McCallum, S.K., "Discretion in Decision-Making: A Problem for Environmental Impact Assessment", *Chitty's Law Journal*, Vol. 23, No. 3, 1975. pp. 73-79.

McEvoy, James III and Dietz, Thomas. *Handbook for Environmental Planning: The Social Consequences of Environmental Change.* New York: Wiley, 1977. Hardcover, 323 pp. $25.75.

Social/environmental impact assessment strategies are dealt with in seven "thematic" chapters: legal; demography; land use; economics; transportation; sociocultural; and social impact information. Appendices provide an impact checklist, data sources, methods of analysis, case studies and approaches to evaluation of impacts.

Mitchell, Bruce and Turkheim, Richard, "Environmental Impact Assessment: Principles, Practices and Canadian Experiences", in Krueger, Ralph R. and Mitchell, Bruce (eds.). *Managing Canada's Renewable Resources.* Toronto: Methuen, 1977. Paperback, 333 pp. $9.95.

Munn, R.E. (ed.). *Environmental Impact Assessment: Principles and Procedures.* SCOPE 5 Report, Toronto, 1975. Paperback, 160 pp. Available from Dr. T.F. Malone, Holcombe Research Institute, Butler University (Box 192, Indianapolis, Ind., 46208), $10.25.

The report presents a thorough review and synthesis of current practices in environmental impact assessment. Articles in the report were prepared during a two week workshop held at Victoria Harbour, Ontario, January 29 to February 8, 1974 (WISE-SCOPE, Workshop on Impact Studies in the Environment – Scientific Committee on Problems of the Environment). The book is being updated; to be published by Wiley.

New York State Dept. of Environmental Conservation. *State Environmental Quality Review Act: Handbook for Local Government.* The Dept. (50 Wolf Road, Albany, NY 12233), 1976 and updated. 82 pp. Free.

The State's SEQRA recently mandated environmental impact assessment at the municipal level. This Handbook explains EIA procedures and provides guidelines for preparing impact statements.

Odum, Eugene P., "The Emergence of Ecology as a New Integrative Discipline", *Science* 195, No. 4284, March 25, 1977, pp. 1289-1293.

Special reference is made to impact statements and the fact that ". . . most impact statements, now almost mass produced, are inadequate because they focus on the wrong level – often, for example, on the species or factor level when the questions and decisions clearly involve the ecosystem level".

Odum, Eugene P. et al. *Totality Indices for Evaluating Environmental Impact: A Test Case – Relative Impact of Highway Alternatives. Use of a Simple Linear Analysis Provides a Means for an Objective Quantification of Environmental Impact.* University of Georgia, Institute of Ecology (Athens, Georgia 30602) and Georgia State Department of Transportation, March 1973. 24 pp.

The assessment procedure is computerized and involves an "ecological systems analysis" of 56 component values. The aggregation process consists of normalizing components to make them commensurate, weighing the present and future impact for each component, weighing the relative importance of each, and summing up to obtain an impact value for each alternative. See also: University of Georgia, Institute of Ecology, *Optimum Pathway Matrix Analysis Approach to Environmental Decision Making Process*, 1971.

Plan Canada, March 17/1. Special Issue on EIA and urban planning, edited by Reg Lang and Audrey Armour.

Plantown Environmental International.

Guide for Environmental Assessment. U.S. Department of Housing and Urban Development (Washington, DC 20410) June 1975. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Subscription Stock No. 023-000-90151-0. Binder, $20.00.

Field office edition providing technical guidelines for reviews of projects. Part I: Introduction (purpose and scope; relevant regulations and legislation; overview of philosophy of environmental assessment; basic approach; organization). Part II: Administrative Issues in Field Office Technical Assessment (relationships between administrative and technical decisions; the EIS; field audit and monitoring; etc.). Part III: Directions for Use of Technical Assessment Guidance Materials (how to proceed with environmental assessment; types of useful information; agency sources). Part IV: Technical Guidance Materials (a comprehensive descriptive checklist of environmental components including geology; soils; special land features; water; biota; climate and air; energy; services; safety; physiological well being; psychological well being; sense of community; visual quality; and historic and cultural resources).

Plewes, M. and Whitney, J. (eds.). *Environmental Impact Assessment in Canada: Processes and Approaches.* University of Toronto, Institute for Environmental Studies (Toronto M4S 1A4), September 1977. Paperback, 199 pp. $5.00.

Proceedings of a symposium on EIA. Topics covered include a critique of the Canadian approach to EIA, impact assessment methods, public participation, ecological modeling, indices of environmental quality, team processes, and hindsight evaluation.

Proctor and Redfern Ltd. *Marmion Lake Generating Station. Community Impact Study. Phase I Report.* Ontario Hydro, Route and Site Selection Division (700 University Ave., Toronto M5G 1X6), January 1976. 60 pp. + app.

Typical of the community impact studies undertaken by Ontario Hydro to determine potential problems and opportunities, especially for community services and infrastructure, likely to result from the construction and operation of major energy facilities. See also: 4.7 Energy Projects, especially Case Study 73.

Rodgers, Joseph Lee. *Environmental Impact Assessment, Growth Management and the Comprehensive Plan.* Cambridge, MA: Ballinger Publishing Co., 1976. Hardcover, 105 pp. $16.50.

Promises (but does not quite deliver) techniques for integrating environmental impact assessment and urban growth management into a process of comprehensive planning; more aptly described as an attempt to develop perspectives and concepts. Most of the text is given over to a survey of the effectiveness of federal, state and local responses to environmental problems, environmental impact assessment and other environmental control measures.

Ross, John H. *Quantitative Aids to Environmental Impact Assessment.* Environment Canada, Lands Directorate (Ottawa K1A 0E7), Occasional Paper No. 3, April 1974. 31 pp.

An example of a cross-impact matrix approach. Two matrices have been devised, a component interaction matrix and a disruption matrix. The method, involving matrix multiplication to derive chains of effects, was used in the *Environmental Assessment of Nanaimo Port Alternatives* conducted in 1973 and published by Environment Canada.

Royal Commission on the Northern Environment. *Interim Report and Recommendations.* The Commission (55 Bloor St. W., Toronto), April 1978. 39 pp. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8). Free.

Established by an Order-in-Council on 13 July 1977, Ontario's Royal Commission on the Northern Environment has three tasks: to assess the environmental and social/economic effects of proposed major development projects in Northern

Ontario, to recommend methods for their assessment, and to examine alternative uses for northern resources. The interim report makes six recommendations that deal mainly with policy and organizational issues.

Schlesinger, Benjamin and Daetz, Douglas. *Development of a Procedure for Forecasting Long-Range Environmental Impacts.* Stanford, CA: Stanford University, 1975. 137 pp. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA22161), PB-224 974, $8.00.

Annotated in 4.4 Resource Development.

Schwind, Paul J., "Environmental Impacts of Land Use Change", *Journal of Environmental Systems*, Vol. 6, No. 2, 1976-77, pp. 125-145.

Sorenson, Jens C. *A Framework for Identification and Control of Resource Degradation and Conflict in the Multiple Use of the Coastal Zone.* University of California, Dept. of Landscape Architecture (Berkeley, CA 94720), 1971. 40 pp.

Annotated in 3.4 Marine Coastal Zone.

Stone, D. and Eedy, W., "Environmental Assessment for Municipal Projects", *Civic*, Vol. 30, No. 2 pp. 6-7, 33.

U.S. Department of Transportation. *Environmental Assessment Notebook Series.* Washington, DC: The Department, 1975. U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 50-000-00109-1, $21.00 per 7-part set (sold in sets only) + 25% outside U.S.A.

Annotated in 4.5 Transportation.

University of Guelph, Centre for Resources Development. *Location Hydro.* University of Guelph, Centre for Resources Development (Guelph, Ont. N1G 2W1), n.d., about 1976. 166 pp.

Done for Ontario Hydro. Annotated in 3.5 Scenic Areas.

Warner, Maurice L. et al. *An Assessment Methodology for the Environmental Impact of Water Resource Projects.* Washington DC: U.S. Environmental Protection Agency, Office of Research and Development, 1974. 221 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $3.00 + 25% outside U.S.A.

Wilkinson, Paul F. *Environmental Impact of Outdoor Recreation and Tourism.* Vance Bibliography (P.O. Box 229, Monticello, IL 61856), Aug. 1978. 90 pp. $9.00.

Annotated in 4.6 Recreation.

Wolf, C.P. (ed.). *Social Impact Assessment.* Environmental Design Research Association (6959 West Glenbrook Road, Milwaukee, WI 53223), 1974. Paperback, 198 pp. $5.50.

Proceeding of a workshop at the EDRA 5 Conference. The 10 papers cover the state of the art of social impact assessment, its legal rationale, SIA in relation to the National Environmental Policy Act, a systematic approach to SIA, methods, and social impacts of urban highways, nuclear power plants, strip mining, open land and flood management. Wolf edits a monthly newsletter, Social Impact Assessment (available from C.P. Wolf, Environmental Psychology Program, CUNY Graduate Center, 33 W. 42 St., New York, NY 10036); subscriptions cost $10.00 for institutions, $5.00 for professionals and $3.00 for students.

5.6 Organizational Arrangements

An inescapable feature of much public planning, and of environmental planning in particular, is that issues and actions to cope with them tend to transcend the boundaries of individual agencies (Friend et al.). The more complex the issue the more likely this is true, and the more difficult it will be for the issue to be resolved by one organization at a single point in time. New issues such as energy, not envisioned when existing jurisdictions were created, cause similar problems. Solving them requires a capacity to appreciate the *structure* of both the substantive problems themselves and the institutional relations that respond to them.

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Institutions

Daniel Bromley and his economist colleagues at the University of Wisconsin-Madison and the University of Alberta (see Information Resources) describe the nature of an institution, separating it from the narrower concept of an organization:

> *An institution is seen to be more than merely an organization. It is a method of approaching problems and dealing with issues, sometimes in a manner requiring the intervention of a collective body, other times operating through informal but often socially powerful conventions. A significant function of institutions is the definition and allocation of rights among society's members and between society collectively and its members individually.*
>
> *Institutions . . . are those social decision systems which, by defining the working rules, accommodate change and reconcile conflicting demands . . . The value of institutions is that they define or establish property rights, and in doing so, they determine relationships among individuals by enabling them to internalize what would otherwise be externalities . . . Institutions are society's attempt to direct the changes caused by growth and development in an acceptable way and are the means of resolving the conflicting demands of different interest groups.*

Organizations are concerned with procuring basic resources necessary to discharge their responsibilities (legal powers, money, staff, data, etc.), allocating these resources to various functions inside the organization, and supervising actual deployment of resources. Environmental problems, which do not fit neatly into organizational mandates, generate demands for responses often unfamiliar to existing organizations. Such problems may challenge present allocations of resources, organizational structures and ultimately the legitimacy of institutions. Governments have tended to react to these challenges in three ways (the author):

> *Horizontal multiplication of departments and agencies at each level of government.* Problems arise when a single new organization is created to integrate environmental concerns. Since these concerns are pervasive, they tend to result in a super-department that quickly clashes with existing organizational unity; furthermore, it soon becomes subdivided in order to fulfil its obligations. Interdisciplinary jealousies compound inter-organizational rivalries.
>
> *Vertical shift of specialized functions from lower to higher levels of government or vice versa.* A variant on this approach is to decentralize operations or increase field services to improve the organization's ability to deal with variety.
>
> *Creation of autonomous special-purpose agencies.* Ontario's Conservation Authorities provide one of the more successful examples (see Ontario Ministry of Natural Resources).

The formidable problem produced by each of these "solutions" is how to achieve, among the various organizational units involved, the integration demanded by the complex and fragmented nature of environmental problems. "Coordination", the usual response, has different meanings (related activities tied to a common set of objectives? mutual adjustment as proposed by Lindblom? avoiding stepping on each other's toes?). Different concepts of coordination lead to various coordinative mechanisms, often unclear as to their purpose and ineffective in their operation (see Downs).

Various options exist for changing the structure of an organization and the way it operates in order to introduce environmental considerations, realize environmental objectives, overcome conflicts and settle jurisdictional differences among organizations. For example:

- Establish working committees or task forces between units and among levels of government. Set up "floating coordinators" – individuals or small temporary units whose job is to interrelate relevant activities within and among organizations (Friend's "reticulist" function).
- Improve information flows and communication between organizations with similar environmental interests or responsibilities. B.C.'s Environment and Land Use Committee Secretariat is an example.
- Restructure an organization, such as a planning department, to reflect environmental concerns (e.g. City of Mississauga).

- Reorient an organization's goals and objectives, either by making environment a higher priority (by political fiat or administrative discretion) or by expanding its agenda. Environmental assessment processes have sometimes produced this effect.
- Define new environmentally related tasks (e.g. produce an environmental policy plan such as that of the Regional Municipality of Waterloo).
- Provide new tools, recognizing that an organization's behaviour may be altered by the information accessible to it and by the range and effectiveness of available implementing mechanisms (e.g. Toronto Central Waterfront Planning Committee).
- Upgrade the power and status of organizations whose interests and tasks are already pro-environmental (strengthening an Environment department, for instance).
- Introduce new organizational arrangements, either adding to or supplanting existing ones (e.g. the Ecological and Environmental Advisory Committees established by several Ontario municipalities including the Regions of Waterloo and Halton).
- Experiment with innovative, temporary, environmentally oriented organizational approaches. Mediation of environmental controversies falls into this category (see Baur, Rivkin; also Alexander).
- Restructure the entire organization and its relations with other organizations. This formidable step is rare at the local level (one example is San Diego County, California) but more common at provincial and federal levels (Ministries or Departments of the Environment, for example).

Organizations are among the instruments for environmental intervention. But they may also constrain or even subvert it, adversely influencing both the planning process and its products. Organizations have both *output* objectives, which describe their basic reason for being, and *survival* objectives which tell what the organization must achieve in order to enable it to continue. An output objective might be to control pollution or to provide a specific service; typical examples of survival objectives are to increase the organization's influence, acquire necessary financial resources, protect its image or hide its mistakes. Output and survival objectives tend to compete and the latter often supersede the former. Then, substantive objectives tend to be satisfied by the rhetoric of policy statements and press releases, and survival objectives (including those of ambitious individuals) become the dominant reality. This subtle process, heavily obscured, exploits dedicated people sustained by hope for change and improvement.

Another common problem in organizations is structure unsuited to task. Bureaucracy, the most prevalent structural form, has certain prominent characteristics: a well-defined chain of command with a hierarchy of explicit authority-status relationships; highly specific division of labour through task specialization; an impersonal codified system of roles and procedures for handling routine activities and expected contingencies; acceptance of tenure, seniority and technical competence as the bases for promotion and remuneration; separation of administration from ownership; and the assumption that, given the foregoing structure and impartial treatment, members will work in an organizationally rational manner (Basil and Cook). Contrast the reality faced by a typical planning office: an ambiguous mandate or mission; vague organizational goals; an unpredictable and elastic work agenda; a diversity of interests, with many regular points of contact or "clients" within and outside the organization; pressure to achieve integration across several dimensions at once (from an environmental perspective, among various functions, both area-wide and for sub-areas such as neighbourhoods or other environments, etc.); and roller-coaster morale. Typically, planning offices have to be capable of flexible adaptation and response to changing conditions (such as a pro-growth council one year and an anti-growth council the next), dealing with varying kinds and scales of integration, resolving conflicts that inevitably arise intra- and inter-organizationally, achieving multi-directional communication, monitoring/feedback and continual reality-testing, and ongoing learning.

Bureaucratic structures, suited to predictable environments requiring routine responses, are less appropriate to highly complex situations characteristic of environmental planning and management. Conditions which reduce essential organizational adaptiveness include: increase in

levels of supervision; control by detailed procedures instead of by evaluation of results (conformity becomes more important than outcome); standardized communication channels closely linked with the authority of the hierarchy and confined to one-way orders or decisions rather than two-way information and advice; decisions reached by use of power and bargaining with suppression of conflict, rather than by reliance on knowledge and open analysis of reasons underlying the conflict; insulated inward-looking top management with primary commitment to and vested interest in past decisions; and self-selection of managerial incumbents with in-breeding through a restrictive internal promotion system (Basil and Cook). Alternatives to the bureaucratic structure and style of operation exist – bureaucracy modified to increase its flexibility, lateral organization, modular or matrix structure, etc. – but experience with them remains limited and not well known. The relationship of organizational structure to the peculiar demands of environmental problems is still largely unexplored territory.

At another scale are organizational arrangements for the planning task itself. A key problem here is to bring to bear on a set of environmental problems the necessary range of knowledge and skills. Interdisciplinary teams are the standard response. They are not the common reality for planners, however. A recent study (Page and Lang) found that a planner is much more likely to work with one or two others, or even alone, than in a planning team. And where such teams are used, the difficulties are considerable. Alonso observes:

> *The team brings together members of different intellectual species, and some of these species rarely mix. They will use words differently, attribute different importance to various aspects, and have different views of their own and others' competencies and interests . . . With time, tolerance and patience, they will come to understand each other better, but great areas of each discipline have logical and symbolic foundations which cannot, except imperfectly and through extraordinary effort, be melded with other disciplines . . . The fundamental differences among disciplines explain why so many inter-disciplinary team reports are not true collaborations but collections of chapters individually authored.*

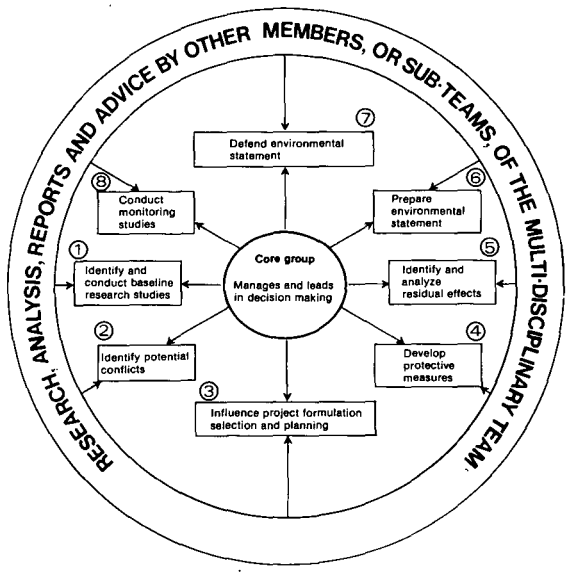


Figure 5.10 The Multidisciplinary Environmental Team

Source: J.W. Greenall, "The Core-Group as a Method for Integrating the Work of the Multi-disciplinary Environmental Team", in M. Plewes and J.B.R. Whitney (eds.), *Environmental Impact Assessment in Canada: Processes and Approaches* (Toronto: University of Toronto, Institute for Environmental Studies, Feb. 1977). Reduced with permission.

Greenall, exploring the question of how best to ensure that environmental concerns are addressed throughout a project's development and not just tacked on as an after-thought, offers one way out of the foregoing difficulties; establishment of a small core group of generalists to manage the planning effort and direct the inputs of a larger group of environmental specialists required from time to time. Though other models of practice do exist (e.g. Wilson, for environmental assessment, Hermann for the plan review process) they are scarce and there is no consensus on their application.

In general, strategies appropriate for reducing and responding effectively to institutional complexity generated by environmental issues lack agreed theoretical frameworks that would clearly guide environmental planners and managers in particular circumstances. Organizational responses, therefore, will continue to vary according to their institutional settings and the specific environmental problems they confront.

Case Study 94
Okanagan Basin Study and Agreement
Submitted by Ken Redpath, Environment Canada, Pacific Region

The Okanagan Basin is located in the southern interior of British Columbia. Much of its population (153 970 in 1976) is concentrated in the centres of Vernon, Kelowna, Penticton and Oliver-Osoyoos. Originally dominated by the resource sectors of agriculture, forestry and mining, the Basin's economy has moved to dependence on secondary and tertiary activities associated with manufacturing, tourism and service industries. Recently the region has also become attractive as a retirement area. Economic growth and population increase have been accompanied by conflicting demands on land and water resources, however. Water quality and quantity are the two main development issues.

The overall objective of the Okanagan Basin study was to produce a comprehensive framework plan for the development and management of Okanagan water resources to achieve the social well-being, economic growth and environmental quality objectives of the Okanagan community. The Study was a federal-provincial cooperative arrangement under *The Canada Water Act.* Duration of the Study was October 1969 to March 1974. The Study was carried out under the general direction of a six-member Canada-B.C. Consultative Board. The Board appointed the Okanagan Study Committee to carry out joint planning studies for the 1969-74 planning period.

In order to implement the framework plan (consisting of 45 recommendations) Canada and B.C. signed a five-year Okanagan Basin Implementation Agreement in February 1976. It provides for 50-50 federal-provincial cost sharing ($2.5 million each). Central Mortgage and Housing Corporation, under the National Housing Act, agreed to provide an additional $17 million in loans and grants for sewage treatment projects. The Agreement also provides for the implementation of specific portions of the framework plan under ongoing federal and federal and provincial programs; no Agreement funds are available for these programs. Overall responsibility for implementation of the Agreement rests with the four-member Canada-B.C. Okanagan Basin Implementation Board. A program coordination and implementation office has been established in Penticton. Local, provincial and federal agencies will be involved.

Refer to:
Canada-British Columbia Okanagan Basin Agreement, *Main Report of the Consultative Board,* 1974.

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Case Study 95
Land Planning and Management in the Qu'Appelle Valley
Submitted by Lorne Sully, Saskatchewan Municipal Affairs

The 250-mile Qu'Appelle River basin encompasses an areas of 20 000 square miles (over 50 000 km^2). Some 300 000 people within its boundaries depend on the river system for water supply, recreation and other needs. The region, however, has suffered from deterioration in its lake environments, landscape despoilation, loss of wildlife habitat, inadequate land use planning and insufficient local resources to prepare and implement necessary plans.

The Qu'Appelle Basin Study Board collected basic data on present and projected conditions in the basin, formulated planning objectives, analyzed and evaluated alternative means of water and related land management to achieve these objectives, and prepared a Framework Plan covering water quality and supply, land and water use, flood prevention and control, and other measures. In October 1975 the Province of Saskatchewan and the Government of Canada signed a ten-year Agreement, based on the Board's report, calling for expenditures of $33.7 million to protect and improve the Qu'Appelle environment and to develop the tourism and recreation industry in the Valley. Two-thirds of the funds are allocated to environmental improvement and management. Included is $1 million for land use planning which the governments believe is necessary to protect their large investment, ensuring that (for example) agricultural land protected from flooding does not end up being paved over and that money spent on improving water quality is not cancelled out by increased pollutants added to the water from poor land use.

Through an amendment to the Urban and Rural Planning and Development Act, the Province created special Area Planning Commissions. Six of these have been established with representation from municipal governments, the provincial government and local interest groups. The Commissions, which have decision-making authority under the Planning Act, are involving themselves with staff from the Qu'Appelle Implementation Office and the public to prepare future land use plans for the Valley; they also hold regular meetings and make decisions on applications for changes in the use of land. This approach has enjoyed considerable success, especially in stimulating local interest in land use planning and an appreciation of its value.

Refer to:
Report of the Qu'Appelle Basin Study Board, 1972, 65 pp. Available from Queen's Printer (Legislative Bldg., Regina.), $1.00, annotated in 5.4 Plans. Various other documents (e.g. on the river system, on water quality, on flora and fauna, land use zoning maps and a newsletter) can be obtained from the Qu'Appelle Implementation Office (Fort Qu'Appelle, Sask. S0G 1S0).

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Case Study 96
Greater Charlottetown Environmental District
Submitted by Kingsley Lewis, Charlottetown Area Regional Planning Board

The Charlottetown Area Regional Planning Board is a joint planning board formed under the P.E.I. Planning Act, with representation from 15 Charlottetown area municipalities and three unincorporated areas. Shortly after its formation in 1975 the Board became concerned about the environmental impact of a number of development proposals in its jurisdiction including a $22 million expansion to the Charlottetown airport, protection of the water supply, septic tank failures pollution and siltation of streams, a sanitary landfill, sewage disposal from an industrial park, and undirected subdivision practices. Negotiations with the P.E.I. government led to the passing of the Greater Charlottetown Environmental District Act which, among other things, placed a one-year moratorium (since extended) on new development and subdivision of land.

The Act, proclaimed in May 1977, also provided that the Board prepare a regional plan for the 6 000 acres involved. While not yet complete, the work has involved an environmental analysis which presents, in map and preliminary text form, an approach to evaluating development applications based on development assistance rather than zoning or subdivision regulation. The approach postulates that no land is actually undevelopable; rather, costs escalate as more elaborate safeguards are needed for environmental protection. The Board, which will be the implementing agency for the plan, is considering an approach which will provide direct assistance to potential developers in preparing subdivision plans and similar proposals.

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Information Resources

See also:
5.1 Environmental Planning in a Management Framework
5.4 Plans

Alexander, Tom, "A Promising Try at Environmental Detente for Coal", *Fortune*, 13 February 1978, pp. 94-102.

Discusses the National Coal Policy Project, a unique experiment with an organizational structure comprising 30 representatives of coal industries and 30 environmentalists (spearheaded by the Sierra Club) meeting in five task forces over an extended period to try and agree on how to deal with environmental and economic problems surrounding the increased exploitation of coal resources in the United States. Described further in 4.4 Resource Development, Case Study 62.

Alonso, William, "Beyond the Inter-Disciplinary Approach to Planning", *Journal of the American Institute of Planners*, May 1971, pp. 169-173.

Ball, A.T. *Regional Environmental Management: Implementation and Institutional Strategy in the Twin Cities Metropolitan Area.* U.S. Environmental Protection Agency (Washington, DC 20460), 1975. 124 pp.

Describes the efforts of the Metropolitan Council of the Twin Cities Area, created in 1967, to coordinate planning and development affecting the environment. The Council's development framework is an area-wide land-use plan. Regional functional planning/management is carried out by regional commissions but, under a 1974 state law, their plans (as of 1977, waste control, transit, highways, parks) must conform to the Council's policy plans which encompass identification of basic needs, service areas and growth assumptions and projections. Similarly, local government land use and public facilities plans must be consistent with the regional plan. See also O. Bryum and R. Hoffman, "Development Framework Guides Regional Land Use, Public Facilities", *Practicing Planner* (American Institute of Planners), March 1977, pp. 20-28. Also, *Natural Resources Model Ordinances*, January 1977, available from the Metropolitan Council (300 Metro Square Building, Seventh and Robert Streets, St. Paul, MN 55101).

Basil, Douglas C. and Cook, Curtis W. *The Management of Change.* New York: McGraw-Hill, 1974.

Baur, E. Jackson, "Mediating Environmental Disputes", *Western Sociological Review*, Vol. 8, No. 1, 1977, pp. 16-24.

Annotated in 5.8 Public Participation.

Beckhard, Richard. *Organization Development: Strategies and Models.* Reading, MA: Addison-Wesley Publishing Co., 1969. Paperback, 119 pp. $3.75.

Organization development is defined here as an effort (1) planned, (2) organization-wide, and (3) managed from the top, to (4) increase organization effectiveness and health through (5) planned interventions in the organization's processes using behavioural-science knowledge. (Note that other views are held in the field, e.g. stressing sharing among members of an organization rather than top-down initiatives). The book introduces concepts, strategies and tactics of OD.

Beer, Stafford. *Brain of the Firm: The Managerial Cybernetics of Organization.* London, England: Allen Lane The Penguin Press, 1972. Hardcover, $10.95.

A study of organizations and their problems based on a study of the human nervous system. Part I examines what is special about today's managerial problems, concepts from cybernetics, the fundamental problem of complexity and how to measure and manipulate it, the nature of self-organization in large complex systems (how to facilitate regulation without imposing it) and the real meaning of hierarchy in organizations. Part II discusses the use of models to disclose the key structure of the system under study, the human body as a known-to-be-viable system as a model, autonomic control by the nervous system, the regulation of internal stability and the level of conscious direction (the brain) leading to a model of the management of any viable system. Part III elaborates a corporate model based on the human body and sets out guidelines for operationalizing the model. See also Ashby and George in 5.7 Regulation and Review.

Bella, David and Williamson, K.J., "Conflicts in Interdisciplinary Research", *Journal of Environmental Systems*, Vol. 6, No. 2, 1976-77, pp. 105-123.

Bromley, Daniel W. et al. *Institutional Design for Improved Environmental Quality: Legal and Economic Aspects in Wisconsin.* University of Wisconsin, Sea Grant College Program (1800 University Ave., Madison, WI 53706), Oct. 1977. Paperback, 251 pp.

Environmental problems create special institutional problems. This report is concerned with alternative organizational structures for providing environmental services, especially "regional environmental quality authorities" (with special application to water quality problems in the Fox River Basin of Northeastern Wisconsin). It begins with a general discussion on institutions and environmental quality. The authors provide criteria for evaluating environmental institutions (e.g. they should have power sufficient to influence outcomes, they must be able to perceive the consequences of their actions, those with power must be identifiable and accountable), then go on to examine alternative organizational structures (pluralist vs. representative government models) for the provision of environmental quality services. A set of ideal criteria for designing environmental institutions is formulated (representative, comprehensive, integrated, non-imposed) and applied to the case study in water quality management. See also Haefele and McMillan.

Castrilli, J.F. and Dines, A.J. *Control of Water Pollution from Land Use Activities in the Great Lakes Basin: An Evaluation of Legislative and Administrative Programs in Canada and the United States.* International Joint Commission (100 Ouellette Ave., Windsor, Ont. N9A 6T3), March 1978. 109 pp. Free.

Annotated further in 2.3 Water Quality, this report examines the numerous jurisdictions whose activities address the control of pollution from land use activities in the Basin. Fragmentation of authority for land use/development planning and water pollution control is seen to inhibit the effectiveness of nonpoint controls. A more intensive treatment of the same subject, focusing on Canada, is: Castrilli, *Control of Water Pollution from Land Use Activities in the Canadian Great Lakes Basin: An Evaluation of Legislative, Regulatory and Administrative Programs* (IJC, 1977). The principal agencies and government levels with roles in the control of water pollution from land uses in the Canadian part of the Basin are identified and their policies and control efforts are evaluated.

Conn, M.D. *Environmental Management in the Malibu Watershed: Institutional Framework.* U.S. Environmental Protection Agency (Washington Environmental Research Center, Office of Research and Development, Washington, DC 20460), June 1975. 107 pp.

Describes and analyzes environmental problems and institutional responses in the watershed of Malibu Creek, north of Los Angeles.

Crook, R.L. *Towards a Land Use Management Philosophy in British Columbia.* B.C. Environment and Land Use Committee Secretariat (Parliament Buildings, Victoria V8V 1X4), 1976. 34 pp.

This paper, presented to the Conference on Monitoring for Environmental Protection at the University of British Columbia in February 1976, describes the present institutional framework that applies to environmental resources in B.C. and how it developed. It then discusses the operation of the Environment and Land Use Committee and its Secretariat. The E.L.U.C. is a cabinet committee made up of nine provincial ministers. Resource conflicts filter up through the hierarchy and those that cannot be resolved are brought to the Committee's attention. It then procures whatever technical information is necessary and undertakes studies. When a decision is made it is transmitted back to the working departments or jurisdictions concerned. The Committee's work is making the need for an environmental data base apparent.

Davis, Larry N. and McCallon, Earl. *Planning, Conducting and Evaluating Workshops.* Austin, TX: Learning Concepts, 1974. Paperback, 310 pp. Available from NTL/Learning Resources Corporation (7594 Eads Ave., La Jolla, CA 92037). $11.50.

A how-to-do-it book on setting up and running workshops (defined as group meetings in which adult learning is the primary purpose).

Delbecq, Andre L. et al. *Group Techniques for Program Planning: A Guide to Nominal Group and Delphi Processes.* Glenview, Il: Scott, Foresman and Co., 1975. Paperback, 174 pp. $6.50.

Program planning is defined as a prearranged set of activities which specify the means to achieve a goal; a program is the means-ends sequence necessary to provide a specific service or product. Two group techniques are focused on in this book: the Nominal Group Technique (a structured group setting in which people generate ideas on paper, share all ideas and vote to determine priorities and the Delphi Technique (systematically soliciting and collating judgements on a particular topic through a set of carefully designed questionnaires, interspersed with summarized information, administered to a group of "experts" in two or more rounds with results and opinions from earlier responses feedback in each round).

Downs, Anthony, "What this profession really needs is 5¢ worth of irrationality", *Planning* (American Society of Planning Officials), July 1974.

Downs' Law of Imperfect Control states: within any large organization it is impossible to achieve perfect coordination, and the bigger the organization the less adequate the coordination. Corollaries are: 1. everyone in such organizations can always be criticized, correctly, for not having adequately planned or coordinated his or her behaviour with others; and 2. administrative organizations can never be perfectly organized since there is no one best way to organize any complex activity – rather, large organizations are constantly being reorganized in response to the criticism that they are not fully coordinated.

Edmunds, S. and Letey, J. *Environmental Administration.* New York: McGraw- Hill, 1973. Hardcover, 517 pp. $15.50.

Section 4 is a readable overview of the implementation of programs in environmental administration – a concept of managing human affairs in such a way that biological health, diversity, and ecological balance will be preserved. Environmental administrators, therefore, are decision-makers whose resource allocation or product design affects ecological life cycles. Annotated further in 5.1 Environmental Planning in a Management Framework.

Faludi, Andreas. *Planning Theory.* New York: Pergamon, 1973. Paperback, 306 pp. $9.00.

Basic text in the theory of primarily urban and regional planning. Chapter 13 is "The Organization of Planning Departments". See also Chapter 4, "A Model of Planning Agencies", Chapter 5, "The Operations of Planning Agencies", and Chapter 12, "Decision-making in Planning Agencies".

Ford Foundation. *The Art of Managing the Environment.* The Ford Foundation (320 East 43 St., New York, NY 10017), September 1974. 42 pp. Free.

Annotated further in 5.1 Environmental Planning in a Management Framework. One of the case studies is a regional environmental management experiment in the Vancouver area. The Inter-Institutional Policy Simulator was established in 1970 to develop computer models for pollution, waste disposal, transportation, land use, economics and population. Models were to simulate the effects on Vancouver of alternate environmental policies and management strategies, thereby enabling managers and decision-makers to determine long-range consequences of their actions. The project's core group comprised University of British Columbia faculty, four city department heads, the planning director of the Greater Vancouver Regional District and (later) representatives of the provincial Department of Municipal Affairs and the federal Ministry of State for Urban Affairs. The case study briefly describes progress on the project, various problems it encountered, and its subsequent scaling-down to a more modest level.

Friend, J.D. et al. *Public Planning: The Inter-Corporate Dimension.* London, England: Tavistock Publications, 1974. Hardcover, 534 pp. $22.50.

Annotated further in 1.3 Characteristics of Environmental Planning. See especially Chapter 13 which summarizes the thrust of this complex book. The authors discuss the "reticulist" function of the planner – "initiating and cultivating a network of human relationships, in such a way as to maintain access to information about changing problem situations which he expects to interact in a significant way with those particular types of decision over which he wishes to be able to exert some influence".

Galbraith, Jay. *Designing Complex Organizations.* Reading, MA: Addison-Wesley, 1973. Paperback, 150 pp. $4.95.

Deals mainly with the relationship of the organization to its environment. The organization must learn how to process the increasingly larger quantities and more complex categories of information generated by its environment. This book looks at alternate organizational structures (e.g. creating lateral relations) for coping with these information processing problems.

Gibb, Jack R., "Managing for Creativity in the Organization", in Taylor, Calvin W. (ed.). *Climate for Creativity.* New York: Pergamon, 1972. Hardcover, 304 pp. $14.50.

The author claims that four factors depress creativity in organizations: latent fear and distrust, restricted flow of communication, attempted imposition of motivation, and attempted control of behaviour. To release creativity in the organization, management must generate trust and allow people to take risks and make mistakes; free the flow of communication and feedback (including open expression of conflict); allow more self-determination of goals and self-assessment of performance; and provide for interdependence, experimentation with work and structure, and intrinsic controls.

Greenall, J.W., "Integrating the Work of Multi-Disciplinary Assessment Teams", in Plewes, M. and Whitney, J.B.R. (eds.). *Environmental Impact Assessment in Canada: Processes and Approaches.* University of Toronto, Institute for Environmental Studies (Toronto M5S 1A4), 1977. Paperback, 199 pp. $5.00.

Haefele, Edwin T. *Representative Government and Environmental Management.* Baltimore: Johns Hopkins Press, 1973. $12.00.

Hermann, Barbara A., "The Environmental Review Team", *Planner's Notebook* (American Institute of Planners), Feb. 1975.

Described as Case Study 98 in 5.7 Regulation and Review.

Lawrence, Paul R. and Lorsch, Jay W. *Organization and Environment: Managing Differentiation and Integration.* Richard D. Irwin, 1969. Paperback. $8.50.

Lindblom, Charles E. *The Intelligence of Democracy: Decision Making Through Mutual Adjustment.* New York: Free Press, 1965. Hardcover, 352 pp. $10.95.

In contrast to proponents of comprehensive planning and rational models of organization, the author argues that people and organizations can coordinate with each other without anyone coordinating them, without a dominant common purpose, and without rules that fully prescribe their relations to each other. The meanings of "coordination" are explored. Mutual adjustment and central coordination are set out as extremes. The former is criticized and a series of ways is elaborated to achieve coordination without a central coordinator.

McMillan, Melville L., "Criteria for Jurisdictional Design: Issues Defining the Scope and Structure of River Basin Authorities and Other Public Decision- making Bodies", *Journal of Environmental Economics and Management*, Vol. 3, No. 1, June 1976, pp. 46-68.

Ontario. Ministry of Natural Resources. *Ontario's Conservation Authorities.* OMNR, Conservation Authorities Branch (99 Wellesley St. W., Toronto M7A 1W3), n.d., about 1977. 14 pp.

Ontario's Conservation Authorities Act of 1946 provided the legislative framework for establishing these autonomous intermunicipal organizations, based on watershed boundaries, for the conservation of natural resources. Initially, emphasis was on combating soil erosion, undertaking reforestation and providing jobs for returning servicemen. Hurricane Hazel in October 1974 switched the main focus of Conservation Authorities to flood control and prevention; more recently provision of outdoor recreation facilities has become a prominent activity. The 38 Authorities now cover most of southern Ontario and five areas in the province's north. Locally initiated, each Authority comprises members from participating municipalities and three members appointed by the Province, together with staff. Their programs are financed in part by the Province (and sometimes the federal government) which also assists Authorities in preparing management plans. For a history of the Conservation Authorities and of the conservation

movement in Ontario generally, see A.H. Richardson, *Conservation by the People: The History of the Conservation Movement in Ontario to 1970* (University of Toronto Press, 1974).

Owen, Thomas, "Toward an Interdisciplinary Environmental Association", *Social Impact Assessment* 32, 1978, pp. 15-16 (available at $5.00 per year for individual professionals and $3.00 for students, from the editor, C.P. Wolf, Environmental Psychology Program, CUNY Graduate Center, 33 W. 42 St., New York, NY 10036).

Describes the establishment of the Ontario Society for Environmental Management (544 Conestogo Road West, Waterloo, Ont. N2L 4E2). A similar organization is the National Association of Environmental Professionals (1901 North Moore, Arlington, VA 22209).

Page, John and Lang, Reg. *Canadian Planners in Profile.* York University, Faculty of Environmental Studies (4700 Keele St., Downsview, Ont. M3J 2R2), June 1977. 11 pp. Free (supply limited).

Annotated in 5.3 Monitoring. Part III of the 63-item questionnaire answered by 544 practitioners dealt with the operation of planning offices. Results of the question (43) on planning teams are contained in the final report, not in the above summary.

Perrow, Charles, "The Short and Glorious History of Organizational Theory", in Wexley, Kenneth N. and Yukl, Gary A. *Organizational Behavior and Industrial Psychology.* New York: Oxford University Press, 1975. Paperback, 641 pp. $10.00.

Pfeiffer, J. William and Jones, John E. (eds.). *Organization Development: Selected Readings.* University Associates (7596 Eads Ave., La Jolla, CA 92037), 1977. Paperback, 210 pp.

A useful collection of 42 short readings on organizational development. University Associates publishes numerous references on various aspects of communication, organizations, human relations and community change. A free catalogue is available from their Canadian Office (P.O. Box 203 Station M, Toronto M6S 4T3).

Rivkin, Malcolm D. *Negotiated Development: A Breakthrough in Environmental Controversies.* The Conservation Foundation (1717 Massachusetts Ave. NW., Washington, DC 20036), 1977. 23 pp.

The author, president of a planning and development firm, argues that mediation can be the basis for new methods to resolve environmental disputes by establishing a forum in which divergent interests, each initially accepted as legitimate, may participate in seeking consensus. Pressures to give greater consideration to environmental factors are considerable, he believes, but the politics of land are formidable and resistant to change; new approaches, providing objective standards for environmentally and socially acceptable growth, have yet to be established. "Negotiated development", based on mediation and using environmental assessment prominently, is offered as a promising solution. The approach is explained through two examples (the White Flint Mill in Montgomery County, Maryland, and the New Jersey Coastal Area). Essentials for negotiation are spelled out, and the perils are specified (costs money, takes time and skill, requires monitoring).

Schindler-Rainman, Eva and Lippitt, Ronald. *Taking Your Meetings out of the Doldrums.* Columbus, OH: Association of Professional YMCA Directors, 1975. Paperback, 100 pp. Available from University Associates (7596 Eads Ave, La Jolla, CA 92037 or P.O. Box 203, Station M, Toronto M6S 4T3), $6.00.

Meetings constitute the organizational structure within which much of the work of any organization gets done (or not). This book analyzes what goes wrong in so many meetings and offers practical advice for restructuring and improving the meeting setting. Another source is Leland P. Bradford, *Making Meetings Work: A Guide for Leaders and Group Members* (University Associates, 1976, paperback, 121 pp., $9.60. George Prince, in *The Practice of Creativity: A Manual for Dynamic Group Problem Solving*, (Collier paperback, 1972, $1.95), looks critically at meetings in Chapter 2, "The Usual Meeting – A Study in Frustration" and offers an alternative in Chapter 3, "New Structure, New Roles".

Science Council of Canada. *Policies and Poisons: The Containment of Long-Term Hazards to Human Health in the Environment and in the Workplace.* Ottawa: The Council, 1977. Paperback, 76 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $2.00 ($2.40 outside Canada).

This report, annotated further in 4.3 Solid and Hazardous Wastes, concludes that many of the issues surrounding hazardous materials (asbestos, lead, mercury, oxides of nitrogen, radiation, and vinyl chloride) have been "fueled by an unfortunate lack of perception at senior levels to cover up what is quite genuinely a matter of serious concern". Condemning lack of agency openness in information gathering, access and availability, the Council proposes creating a new federal agency (a National Advisory Council on Occupational and Environmental Health) to monitor and report on poisons in the workplace and the environment.

Self P. *Administrative Theories and Politics.* University of Toronto Press, 1972. Paperback, 308 pp. $6.00.

Attempts to relate administrative theory to administrative practice in different government systems. The book covers a variety of issues related to administrative organization and behaviour including the allocation of functions, staff and line, in government and the nature of administrative conflict.

Wilson, W.M.C., "Integrating the Work of Interdisciplinary Environmental Assessment Teams", in Plewes, M. and Whitney, J.B.R. (eds.). *Environmental Impact Assessment in Canada: Processes and Approaches.* University of Toronto, Institute for Environmental Studies (Toronto M5S 1A4), 1977. Paperback, 199 pp. $5.00.

5.7 Regulation and Review

Acknowledgements 5.7

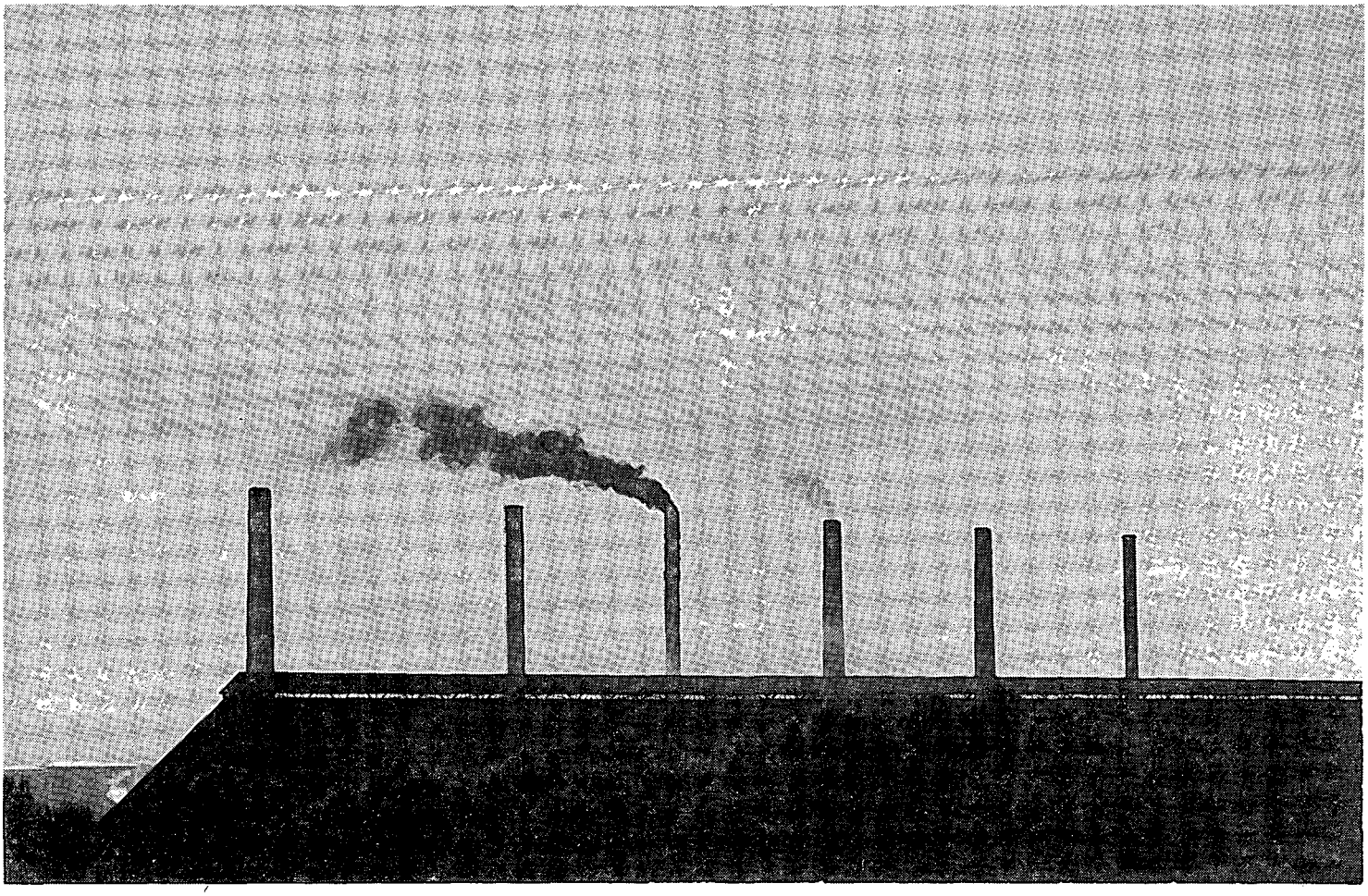
This section includes contributions from:

Linda Cardini
Julia Davidson
Paul Emond
Kingsley Lewis
Lorne Sully
Ken Whiteford
Phil Wood

Regulation in biological systems is a natural process that maintains certain limits beyond which survival is threatened. In cybernetic terms, a regulator controls variety to prevent disturbances to essential variables. Just as the turtle's shell reduces a variety of impacts to negligible disturbance to the sensitive tissues within (borrowing an example from Ashby), a policy reduces a large variety of recurring situations to manageable proportions. Ashby's Law of Requisite Variety dictates that the control must be capable of generating as much variety as the situation to be controlled; it takes variety to cope with variety. For example, a government policy insuffiently attuned to the diversity of specific conditions to which it applies will be ineffective.

In a management sense, regulation and review are key components of the control function which has as its purpose ensuring conformance to plans and responsiveness of the organization to its environment. Policies, standards, regulations and other administrative procedures are determined in relation to broad objectives. Performance is then monitored and reviewed, deviations are corrected, and from time to time the control system itself undergoes change. Such regulation is aimed at an organization's internal operations. Regulatory functions of government agencies are also directed outward, to private firms and individuals as well as to other government agencies. Government regulation aimed at the environment attempts to control certain externalities of development, maintain the quality and quantity of designated environmental resources, reduce hazards and nuisances to the public, protect property, and minimize future costs arising from environmental degradation.

At federal and provincial levels some environmental regulations are made under statutes.



Numerous others result from policies, with varying degrees of political commitment. Such policies, though not legally enforceable, are used by government agencies to decide whether to grant approval to projects and whether to order pollution abatement (Estrin and Swaigen). Included in this category are *guidelines* (often administered on a site-specific basis, strictly between regulator and regulatee), *criteria* (which may set limits for contaminants) and *objectives* (another way of stating maximum tolerated levels of pollutants). Considerable discretionary power is exercised in this regulatory process, its relationship to planning is often obscure, coordination among regulations is problematic, and conflict may arise within a government agency charged with both environmental conservation and the regulation of commercial exploitation of natural resources.

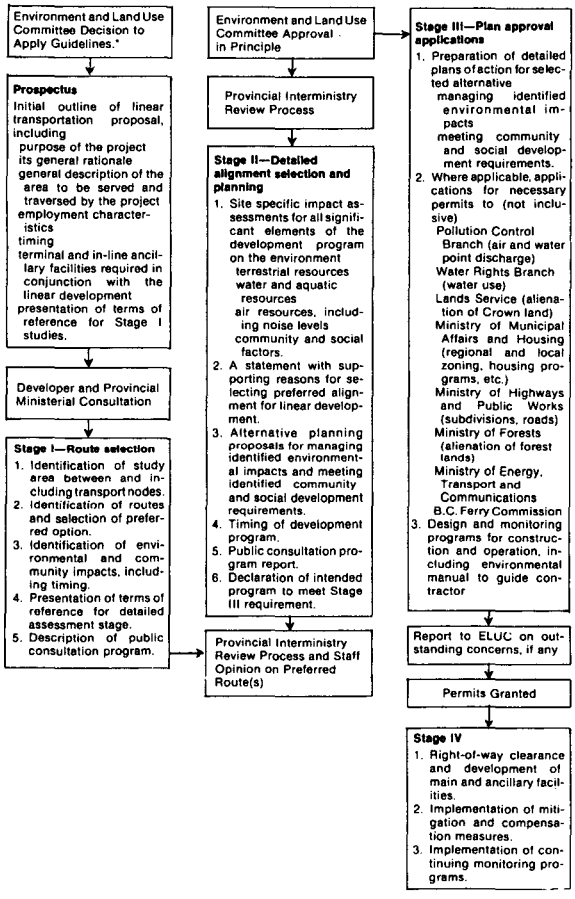


Figure 5.11 Linear Development Assessment and Review Procedure, British Columbia

Source: B.C. Environmental and Land Use Committee, *Guidelines for Linear Development* (Victoria: The Committee, March 1977).

At the municipal level, regulation covers a wide range of activities, many of them related to the use of land and associated development. Aimed broadly at protection of the "health, safety and welfare" of the public, such controls serve a variety of specific purposes: to economize on the provision of municipal services and facilities; to control the physical and cultural character of resulting development; to prevent premature and haphazard development, usually for economic and aesthetic reasons; to maintain a desirable balance among land uses; to achieve corresponding balance among residential, commercial and industrial assessment; and so on.

Minimizing or preventing adverse environmental effects is a recent but significant addition to this list. A 1976 Canada-wide survey found "strained municipal services" and "endangered environment" to be the number 1 and 2 reasons why cities were introducing new growth management measures (Bureau of Municipal Research). Conventional land use controls, however, take insufficient account of environmental effects; they emphasize use more than land. That emphasis is changing as public awareness gradually shifts from land as commodity to land as commodity + resource. But the relationship between regulations and planning at the municipal level, though clearer than at provincial and federal levels, is often tenuous. Regulatory measures such as zoning pre-date the introduction of municipal development/general/official plans. Even today it is not uncommon to find a zoning bylaw that differs from the municipal plan, or to discover other regulatory processes such as the control of land severances being conducted without explicit reference to overall plans. Regulations tend to reflect specific needs and problems, which contributes to the common lack of coordination or consistency among them, both within and between governments. Environmentally oriented regulations raise additional concerns about legal defensibility, insufficient jurisdiction, the political sensitivity of any measures affecting property rights, and public response and acceptability.

At the municipal scale planners and managers have three options: use existing controls to safeguard environmental interests, adapt the process of development regulation and internal control to address environmental concerns, or invent new environmentally oriented control measures. Included in the first category are:

Capital expenditures. Provincial and regional/local municipalities can substantially

influence the amount, timing, rate, location and pattern of urban development and its concomitant environmental impacts by the provision of certain services, especially trunk sewer and water mains, water and wastewater treatment, and major transportation facilities. Relationships between these "growth shapers" and subsequent development is not altogether clear, however (Urban Systems Research & Engineering). Furthermore, criteria other than environmental heavily influence servicing decisions.

Zoning and development control. Zoning bylaws can control the location of land use activities, the form of development (height and bulk of buildings, setbacks, density, etc.) and to some extent its rate. Zoning and subdivision regulations, especially with environmental provisions added, have potential for keeping development away from hazard lands, protecting the character of already-developed areas and isolating noxious uses. But the use of zoning for environmental protection is limited. "A zoning bylaw cannot set out the standards necessary if every individual property were to be treated according to its own particular environmental elements. If this were attempted the zoning bylaw would become unmanageable since all the detailed conditions would have to apply to all lands designated for the same use within the area" (Ontario Ministry of Treasury, Economics and Intergovernmental Affairs). Land uses zoned on a site-by-site basis produce charges of arbitrary and unfair practice. The public agency may come under pressure either to acquire the site or to grant the owner development rights equivalent to those enjoyed by similar sites elsewhere in the municipality. In rural and resource areas, zoning approaches formulated for urban situations will produce additional problems when their use for environmental purposes is attempted.

Some municipalities (e.g. those with official plans in Ontario) may also exercise "development control" which allows more direct regulation and may include provisions such as control over destruction of vegetation during construction. A further power, used by many municipalities, is the requirement that developers convey a certain proportion of their sites, usually 5%, for public park and open space purposes.

Development agreements. These specify conditions to be met by individual developers. Such agreements may provide an opportunity to regulate the environmental effects of construction and, to a lesser extent, later management practices.

Non-land-related regulations. Examples are tree bylaws (seldom used to the full extent possible, as Andresen points out in 2.4 Urban Vegetation) and health regulations.

Informal review processes. A municipality's opportunities to exercise control over develepent arise as much through the informal side of regulation as in the formal exercise of these powers. Negotiations between regulator and regulatee, especially where the latter has a lot at stake and is likely to encounter the former again, allow for the introduction of environmental requirements such as the provision of environmental data, environmental or energy impact analyses, a higher standard of amenities, and dedication of environmentally sensitive lands for public purposes. The informal process is open to abuse, however, including manipulation of either side by the other.

The second category, adapting the process of regulation and review, offers somewhat more promise than the first. Examples include:

Development review criteria. Environmental criteria can be added explicitly to the process of review of secondary and site plans as well as specific development proposals.

Environmental review team. This goes a step further by coordinating the development review process and bringing in environmental expertise as required (see Case Study 98). An advantage of one-stop environmentally informed review is that the combined environmental objections of several agencies may be more influential than single concerns in halting or revising an undesirable project.

Promising new environmentally oriented regulatory approaches are emerging rapidly in practice, though often their longer-term feasibility has not yet been proved. For example:

Performance standards. Traditional "specification" standards indicate what can or cannot be done with a piece of land; they control man-made features rather than protecting environmental processes. The performance standard approach, by contrast, identifies the

functions of the land which provide important public benefits and designs regulations to protect them. Such standards supplement rather than replace conventional zoning procedures. Natural processes suited to protection by performance standards include runoff, erosion, water retention in wetlands, groundwater flow and storage, flooding and surface water supplies. Development is not prohibited in relation to sites affected by such processes. Instead, proposals must demonstrate that they can coexist with the natural processes at the level determined, by environmental analysis, to be necessary for their continued functioning (Thurow et al). Underlying and constraining this approach are the need for a sound data base and well-researched environmental cause- effect relationships, as well as questions of legal defensibility.

Regulation related to capacities. Here, development proposals are judged not only by conformance with the municipal plan but also against available capacities in affected natural systems, public services and municipal finance. Impact zoning, a prominent example of this approach, involves land use analysis to measure the consequences of changes in the community in terms of demands on such capacities (Rahenkamp). Again, the back-up data requirements and the ability of impact zoning to withstand legal challenge are principal concerns. No known Canadian examples exist.

Environmental analysis and assessment. Increasingly, municipalities in Canada and the United States are requiring special environmental studies of development proposals located on or adjoining environmentally sensitive lands (see Case Study 89 in 5.4 Plans, for an example).

Other new forms of control. Included are planned unit development, cluster zoning, contract zoning, transfer of development rights, development timing, holding zones, noise bylaws, scenic easements, and extraordinary controls by special purpose agencies such as the Niagara Escarpment Commission, the B.C. Agricultural Land Commission and the Peggy's Cove Commission.

The fact that regulatory processes are negative in nature should not be overlooked. They can affect how things turn out (and they sometimes may be prohibitive) but they can't make them happen. Environmentally oriented initiatives will often come from developers themselves. Actions of the public sector should include creating incentives to attract and support such initiatives, and ensuring that the public agency possesses the capability necessary to recognize and adequately review them.

Case Study 97
Conserving Remnant Natural Areas on Toronto's Waterfront
Submitted by Linda Cardini, City of Toronto Planning Board

The setting is an urbanized waterfront under multi-jurisdictional control. The problem is to conserve significant remnant natural areas in the face of intensive park development and urban over-use.

Preliminary identification and mapping of significant environmental features occurred during a comprehensive environmental inventory conducted as part of the waterfront planning process under direction of an interagency committee of scientists, engineers and planners and with input from environmental groups. Criteria relating to biological and socio-cultural values were used to identify areas proposed for designation as Environmentally Sensitive in the City's Official Plan. A low-impact recreational use category was proposed for inclusion in the zoning bylaw. Detailed performance standards were formulated and environmental assessment procedures were recommended for public works and park operations. Work was in the unofficial draft stage as of June 1978, making it too early to evaluate its effectiveness and public or political acceptance. Since the lands are publicly owned (provincial and regional municipal governments) implementation will depend largely on the relevant agencies' willingness to accept local direction.

Certain conditions are unique to this project. The planning process itself was established in a strongly pro-environmental context. The Committee overseeing the environmental inventory comprised a range and depth of expertise not easily duplicated. And well-informed environmental groups exerted pressure on the process to maintain its emphasis and strengthen the level of participation.

Refer to: Central Waterfront Planning Committee, *Environment Information Base*, City of Toronto Planning Board (City Hall, Toronto M5H 2N2), 1976. $7.50.

Wallace McHarg Roberts & Todd, *Environmental Resources of the Toronto Central Waterfront*, City of Toronto Planning Board, 1976. $6.00.

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Case Study 98
Connecticut Environmental Review Team

An interdisciplinary review team was established in Eastern Connecticut a few years ago to assist local governments and developers, at no cost, to assess the environmental impacts of proposed large-scale developments. The team uses existing staff of participating agencies from time to time on a loan basis; only its project coordinator is full-time. By early 1975 over 50 reviews had been completed covering residential, recreational, commercial, industrial and other land uses.

Reviews are initiated by a request, from the municipality and the developer, through the County soil and water conservation district. Information is forwarded to the members selected for the team (soil scientists, engineers, geologists, hydrologists, fish and wildlife biologists, climatologists, landscape architects, community planners, etc.). A field review is followed by a summary meeting of the team to discuss the project. Team members then prepare individual reports, using a standard format (the article, below, shows a typical work sheet), which go to the coordinator who prepares the final report.

The review process establishes a natural resource data base and provides interpretations necessary to judge whether development projects should be approved or refused, modified, continued or abandoned. It appears (a) well suited to small communities who experience development pressure but lack professional staff, and (b) appropriate where regional, provincial/state and federal agency personnel are both available and willing to cooperate.

Source: Barbara A. Hermann, "The Environmental Review Team", *Planner's Notebook* (American Institute of Planners), February 1975.

Information Resources

See also:
5.1 Environmental Planning in a Management Framework
5.4 Plans
5.5 Environmental Impact Assessment
5.6 Organizational Arrangements

American Society of Planning Officials. *Transferable Development Rights.* ASPO (1313 East Sixtieth St., Chicago, IL 60637), 1975. 64 pp. $6.00.

Seventeen papers organized under five headings: TDR and historic presentation; TDR and open space preservation (including an article on Puerto Rico, "Preserving the Environment While Protecting Private Property Rights", see Costonis and DeVoy, below); TDR as the basic land use control mechanism with case studies from Fairfax County in Virginia, Colorado, California's Marvin County, and Washington, DC; TDR and the comprehensive planning process; and perspectives for the future. See also: R.M.L. Bellardi and R.D. Hennigan, "The Why and How of Transferable Development Rights", *Real Estate Review* 7, Summer 1977, pp. 60-64; Costonis, below; James, below; and Jerome G. Rose, *The Transfer of Development Rights: A New Technique of Land Use Regulation* (Rutgers University, Center for Urban Policy Research, Building 4051 – Kilmer Campus, New Brunswick, NJ 08903), 1976, $12.95.

Ashby, W. Ross. *An Introduction to Cybernetics.* New York: Wiley, 1963. Paperback, 295 pp. $7.00.

Chapter 6 is "Regulation and Control". See also Stafford Beer, *Brain of the Firm* (London: Allen Lane the Penguin Press, 1972), annotated in 5.6 Organizational Arrangements.

B.C. Environment and Land Use Committee. *Guidelines for Coal Development.* The Committee (Parliament Buildings, Victoria V8V 1X4), 1976. 33 pp. Free.

Describes a planning process designed to achieve a rational approach to control of land use and environmental/community impacts associated with coal development.

B.C. Environment and Land Use Committee. *Guidelines for Linear Development.* ELUC (Parliament Buildings, Victoria V8V 1X4), March 1977. 32 pp.

The Guidelines "outline a comprehensive planning process designed to encourage the careful management of land use and the assessment of environmental and social impacts associated with certain types of linear developments such as major railways, pipelines, transmission lines, highways and industrial roads". Part I describes a four-stage planning process leading to the granting of applicable permits and authorization of projects. Part II contains a detailed list of information sources. Appendices summarize relevant legislation governing linear developments, list contacts in the provincial government, present a glossary of terms and show resource management regions/centres. The ELUC of the Provincial Cabinet administers the Guidelines, under the Environment and Land Use Act, which apply primarily to private projects, Crown corporation projects and certain projects of provincial departments.

Brooks, Mary E. *Housing Equity and Environmental Protection: The Needless Conflict.* American Institute of Planners (1717 Massachusetts Ave. NW, Washington, DC 20036), 1976. Paperback, 130 pp. $10.00.

Concern is often expressed that increased environmental awareness will seriously and unnecessarily undercut efforts to guarantee economic and racial minorities opportunities to benefit

from urban development policies and programs. Substantiating this contention are the use of environmental regulations to exclude low and moderate-income families, and evidence that central city dwellings suffer particularly from environmental degradation. The author analyzes this issue, concluding that "housing rights and environmental protection are so interconnected that to achieve one without devoting parallel attention to the other is to embark on a futile attempt to dissect the urban development process into isolated achievements". She discusses: the nature of the conflict centred on land use; the basis of rational environmental regulations; housing costs and environmental protection; views from the courts; opportunities to balance housing and environment; environmental policies for residential land use; and housing goals in environmental programs. See also Solomon.

Brower, David et al. *Urban Growth Management Through Development Timing.* New York: Praeger, 1976. Hardcover, 153 pp. $16.50.

A variety of control devices are used in growth management systems – some regulatory, some involving public investment and some using policies as decision guides to achieve consistent action. Such devices are most effective, this book argues, when conceived and executed jointly in two realms: one having to do with location and the other with timing (the subject of the book). Chapters discuss: constitutional constraints on growth management in the United States; selected tools and techniques of development timing including large lot zoning, the adequate public facilities ordinance, development moratoria, land banking and taxation; and a survey of selected communities that have undertaken development timing measures to determine how they perceived the development timing problem, which measures were used and how, the objectives they were intended to serve and their effectiveness. Appendices examine several specific examples more closely. See also John Madden, *A Discussion of Timed Development*, New Jersey Federation of Planning Officials (1308 Wood Valley Road, Mountainside, NJ 07092), 1975, 15 pp., $2.00, which concludes with 14 criteria for the use of development timing.

Burchell, Robert W. and Listokin, David (eds.). *Future Land Use: Energy, Environmental and Legal Constraints.* Rutgers – The State University, Center for Urban Policy Research (Building 4051 – Kilmer Campus, New Brunswick, NJ 08903), 1975. Hardcover, 369 pp. $17.95.

See especially the papers: Norman Williams, "The Future of Land Use Controls"; Robert Freilich and David Greis, "Timing and Sequencing Development: Controlling Growth"; and John Rahenkamp, "Land Use Management: An Alternative to Controls".

Bureau of Municipal Research. *Legislative Attempts to Control Urban Growth in Canada.* BMR (2 Toronto St., Suite 306, Toronto M5C 2B6), 1976. 83 pp. $3.00.

Reports the results of a modified Delphi survey of attitudes toward and attempts to control urban growth by 21 metropolitan areas across Canada. A majority of respondents (with considerable city-by-city variation) felt that growth was not a problem and that the community favoured more of it in future. Regulatory approaches to growth, in order of popularity, were found to be the limiting of residential growth, planned unit development, control of building permits and tax incentives. Other questions/answers are provided in the report which then goes on to discuss local legislation for managing growth, by city, with two case studies of urban growth (Vancouver and Toronto) and a summary/conclusion. Further annotated in 4.2 Urbanization.

Comay, E., Berger, E., and Hardy, E. *Report of the Planning Act Review Committee.* Toronto: Ontario Ministry of Housing, April 1977. 187 pp. Available from the Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $3.00, cheque payable to Treasurer of Ontario.

In reviewing Ontario's Planning Act, the Committee made three basic proposals related to environmental planning (which received relatively little emphasis overall): that municipalities be required to have regard for natural-environment concerns in their planning; that they be allowed to exercise particular development control powers explicitly directed to protecting the natural environment; and that in certain circumstances they be allowed to engage in environmental assessment on behalf of the Province. The report advocates legalizing the use of holding zones where changes in land use policy are contemplated, where rural land is being converted to urban use, and on properties that are environmentally sensitive or have other unique locational features. It also proposes authorizing the transfer of development rights for several reasons, among them preservation of privately owned open space free of buildings and retention of axial views or other significant civic design features. The Province (Minister of Housing) is due to present a White Paper on review of the Act in early 1979; one issue to be addressed is streamlining of the two sets of processes under the Planning Act and the Environmental Assessment Act.

Carroll, Allen. *Developer's Handbook.* Connecticut Dept. of Environmental Protection, Coastal Area Management Program (165 Capitol Ave., Hartford, CT 06115), 1976. 60 pp.

Clarifies existing environmental regulations and explains why they are necessary. Chapters discuss land/air/water resources and the coastline, graphically illustrating the large number of environmental factors to be considered in planning and constructing subdivisions. The last chapter presents a systematic approach for developers to use in conducting comprehensive environmental analyses of sites.

Costonis, John J. and DeVoy, Robert S. *The Puerto Rico Plan: Environmental Protection Through Development Rights Transfer.* Urban Land Institute (1200-18th St. NW, Washington, DC 20030), 1975. 52 pp.

TDR is based on the underlying principle that "the development potential of privately held land is in part a community asset that government may allocate to enhance the general welfare. In effect, TDR severs the development potential from the land and treats it as a marketable item in an attempt to mesh the economic forces of the market with the police power authority of government to protect the general welfare. It is also viewed, by proponents, as an equitable means of providing an anticipated return on land investment to property owners whose return might otherwise be lessened by regulatory activity". This report examines the potential contribution of development rights transfer to environmental protection in Puerto Rico where lack of funds to compensate private owners for public encroachment on their land is inhibiting environmental programs. The study proposes a TDR program for Puerto Rico, evaluates the legal issues and assesses the economic and planning issues likely to accompany implementation of such a program.

Council on Environmental Quality. *Environmental Quality: The Fourth Annual Report of the Council on Environmental Quality.* Washington, DC: CEQ, 1973. Paperbook, 449 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $4.30 + 25% outside U.S.A.

Chapter 4, "The Law and Land Use Regulation" discusses the "quiet revolution" (drawn from F. Bosselman and D. Callies, *The Quiet Revolution in Land Use Control*, CEQ, 1971) involving expanded regulation of land use toward environmental objectives. The basic values to be balanced – private property and public environmental concerns – are discussed, the traditional approach to the problem is outlined, the traditional approach in an environmental context is illustrated with several controversies, and recent judicial trends responding to new environmental concerns are noted. The authors conclude that the process of redefining the concept of property is moving in the direction of recognizing land as a resource as well as a commodity. In this transition period, the problem of compensation is particularly acute.

Dewees, D.N., et al. *Economic Analysis of Environmental Policies.* Toronto: University of Toronto Press, 1975. Paperback, 175 pp. $10.00.

Chapters 3 and 4 discuss the benefits and costs of pollution control. Annotated further in 1.2 Characteristics of Environmental Problems.

Ditmer, Robert N. *Impact Zoning: An Introduction and Selected Bibliography.* Council of Planning Librarians (P.O. Box 229, Monticello, IL 61856), CPL #974, February 1976. 24 pp. $2.50.

Dwivedi, O.P. (ed.). *Protecting the Environment: Issues and Choices – Canadian Perspectives.* Toronto: Copp Clark, 1974. Paperback, 339 pp. $6.95.

See especially: David Estrin, "Tokenism and Environmental Protection", and L.C. Green, "Canada, Pollution Control and the Law". Annotated further in 1.2 Characteristics of Environmental Problems.

Environment Canada, Federal Environmental Assessment Review Office. *A Guide to the Federal Environmental Assessment and Review Process.* Environment Canada, FEARO (Ottawa K1A 0H3), February 1977. 20 pp. Free.

Annotated in 5.5 Environmental Impact Assessment. E.A.R.P. is also discussed at length in Estrin and Swaigen, below, and in Emond (Information Resources, 5.5 Environmental Impact Assessment).

Ervin, David E. et al. *Land Use Control: Evaluating Economic and Political Effects.* Ballinger Publishing Co., 1977. Hardcover, 184 pp. $17.50.

Estrin, David and Swaigen, John. *Environment on Trial: A Handbook on Ontario Environmental Law.* Canadian Environmental Law Research Foundation (One Spadina Crescent, Suite 303, Toronto M5S 2J5), revised edition, edited by Mary Anne Carswell and John Swaigen, 1978. Paperback, 587 pp. $6.95.

Part I explains "the rules: how they are made and how they are applied" in relation to environmental law in Canada with special reference to Ontario (The Environmental Protection Act, especially). Part II discusses, among other things, regulatory aspects of various pollution problems. Part III goes into "the planning process" with respect to national and provincial parks, municipal land use planning, heritage conservation, and the right to light and air. Part IV discusses common law rights and remedies, choosing your remedies, and evidence and environmental litigation.

Fairfax County Government, Office of Comprehensive Planning. *Growth, Change and the Environment in Fairfax County: The Environmental Planning Process.* Fairfax County Dept. of Environmental Management, Division of Administrative Services (Massey Bldg., 4100 Chain Bridge Road, Fairfax, VA 22030), September 1974. 99 pp.

Fairfax County, abutting the national capital, has been an innovative pioneer in the field of environmental management. This paper describes its Planning and Land Use Control System (PLUS) program; also available are six earlier research papers, on the program's history, legal basis, evaluative tools, economic aspects, demographic factors and developed/undeveloped land. The major environmental issues, programs to resolve them (environmental impact assessment for guiding plan formulation and evaluating plan alternatives, analysis and allocation of open space lands) and implementation strategies are discussed. An independent critical evaluation of the PLUS program is provided by Grace Dawson, *No Little Plans: Fairfax County's PLUS Program for Managing Growth*, The Urban Institute (2100 M St. NW, Washington, DC 20037), 1977, paperback, 168 pp., $3.95. The author concludes that the program failed to live up to its initial aspirations but nevertheless offers valuable lessons for other communities considering ambitious land use control programs.

Gleeson, Michael E. et al. *Urban Growth Management Systems: An Evaluation of Policy-Related Research.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), P.A.S. 309 and 310, 1975. 141 pp. $12.00.

Annotated in 5.1 Environmental Planning in an Management Framework. The growth management techniques evaluated include controls for environmentally sensitive areas, critical areas (ESAs where the concern extends beyond the local jurisdiction), developments of regional impact, and pollution. Chapter 6 considers the socio-economic impacts of growth management systems.

Green Zone Committee, Ministry of Agriculture and B.C. Land Commission. *Agricultural Zoning and Waste Management.* B.C. Agricultural Land Commission (4333 Ledger Ave., Burnaby, B.C. V5G 3T3), 1977. 57 pp.

Analyzes various development control methods for dealing with agricultural-land conflicts. Annotated further in 4.1 Agriculture.

Hagman, Donald G. and Misczynski, Dean J. *Windfalls for Wipeouts: Land Value Capture and Compensation.* American Society of Planning Officials (1313 East Sixtieth St., Chicago IL 60637), 1978. 704 pp. $23.95.

Compares techniques for recapturing windfall and mitigating wipeout in Canada, Australia, New Zealand, England and the United States. Reviewed by Neal Roberts in *Urban Forum*, Vol. 4, No. 1, May-June 1978.

Hakim, B. and McKenzie, J. "Protecting the View: Citadel Hill, Halifax, Nova Scotia," *Ekistics*, Vol. 39, No. 232, March 1975, pp. 186-191. Reprint available from Nova Scotia Technical College, School of Architecture (P.O. Box 1000, Halifax, N.S.), $1.00.

In 1974, Halifax City Council passed a View Bylaw intended to protect the views of the harbour from Citadel Hill. The bylaw, designed to preserve an historical and aesthetic relationship, protects ten view planes from four viewing positions; different height restrictions apply to different view plans. This ingenious use of existing regulatory powers (i.e. zoning) to achieve an environmental end has had some unexpected side-effects, including environmental. Pressures for development began on sites that would not have been considered appropriate for high-density development in the absence of height restrictions in the view planes. The bylaw is also changing the nature of design; triangular buildings are being built because the view planes are triangular. Some residents find the contrast with existing buildings aesthetically unpleasant. See also Bureau of Municipal Research, above, which discusses the bylaw as a case study.

Hall, Richard C, "The Master Environmental Impact Report – A Method for Evaluating the Environmental Impacts of General Plans", *Design Methods and Theories*, Vol. 10, No. 1, January-March 1976, pp. 15-20.

See Case Study 83 (5.3 Monitoring) which describes the Santa Clara County approach using Resources Accounts to relate development control to various capacities.

Hefferon, Dennis. *Casebook on Land Use Planning.* York University, Faculty of Law (Osgoode Hall Law School, Material Distribution Centre, 4700 Keele St., Downsview, Ont.), 1976/77. $31.00.

Two-volume compendium of materials on the law of land use planning assembled as a text for law and planning students.

Hendler, Bruce. *Caring for the Land: Environmental Principles for Site Design and Review.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), P.A.S. No. 328, 1977. Paperback, 94 pp. $8.00.

Annotated in 5.4 Plans.

Herr, Philip et al. *Evaluating Development Impacts.* Massachusetts Institute of Technology. Laboratory of Architecture and Planning, Environmental Impact Assessment Project (Room 4-209, Cambridge, MA 02139), 1978. 165 pp. $6.50.

Annotated in 5.5 Environmental Impact Assessment.

Hunter, Knowlton, "The Official Plan – Bureaucracy Stikes Again", *Natural Life* (Jarvis, Ont. N0A 1J0), No. 14, 1978, pp. 33-34.

Presents the regulatee's view of planning and development control in a rural county of Ontario. The author questions the reasons underlying certain land use controls (e.g. no more than three persons unrelated by blood or marriage may share a single house regardless of its size) and argues that some of these restrictions, such as minimum floor space of 900 square feet and the prohibition against building underground, run counter to energy-oriented design. He states, "It seems obvious to us in this part of the county, which is now termed marginal argicultural land, that new methods must be considered to make best use of the many old farms now rapidly becoming overgrown and neglected. In an area where land might be returned to usefulness and some degree of productivity in an ecologically and economically aware fashion, these restrictive land use bylaws will only speed the present decay". He and his neighbours have formed a Committee on Land Use (Box 1101, Bancroft, Ont. K0L 1C0) to promote reform of local land use controls.

James, Franklin J. and Gale, Dennis E. *Zoning for Sale: A Critical Analysis of Transferable Development Rights Programs.* The Urban Institute (2100 M St. NW, Washington, DC 20037), 1977. Paperback, 39 pp. $3.95.

TDR makes rights to develop land transferable

among properties or property owners. If development of a property is constricted or denied by the municipality, the owner with TDR has the opportunity to transfer the use rights to certain other properties where existing land use controls are relaxed to permit more intensive development. This brief report assesses the advantages and disadvantages of a number of TDR plans and likely obstacles to their implementation. The authors conclude that TDR, while ingenious, is unlikely to offer advantages over current land use planning tools. They find that TDR implies sizable public expenditures to compensate private owners and achieve specific community goals.

Jantsch, Erich. *Design for Evolution: Self-Organization and Planning in the Life of Human Systems.* New York: George Braziller, 1975. Paperback, 322 pp. $6.75.

In Chapter 1, "Regulation, The Human Predicament", policy is defined broadly as "a set of principles laid out for the purpose of regulating simultaneously and in a viable mode a multitude of interacting relationships pertaining to many qualities and dimensions of human life – in short a theme underlying a life. Many conflicting and confusing forces act upon us from without and within; the human predicament is to design and live in accordance with forms of regulation which will ensure the steering of a viable course". Chapter 14 is "Policy Design - Organization and Regulation".

Juneja, Narendra. *Medford: Performance Requirements for the Maintenance of Social Values Represented by the Natural Environment of Medford Township, N.J.* Philadelphia: Center for Ecological Research in Planning, University of Pennsylvania, 1974. 64 pp. Available from Medford Township Office (Box 397, Medford, NJ 08055), $6.00.

Annotated in 5.4 Plans. The approach used here goes directly from analysis to regulation, apparently bypassing the "official" plan.

Kaiser, Edward J. et al. *Promoting Environmental Quality Through Urban Planning and Controls.* Washington, DC: U.S. Environmental Protection Agency, 1974. Paperback, 441 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), $4.25 + 25% outside U.S.A.

Annotated in 1.3 Characteristics of Environmental Planning, and in 5.4 Plans. See especially Chapter IV: A. Land Use Planning: The Cornerstone of Local Environmental Planning and Control; B. Water Resource Management: Planning and Control Systems for Water-Land Use Interface; C. Urban Design: Managing the Visual Quality of the Urban Environment; and D. Planning and Residuals Management: Noise and Air Quality.

Lucas, A.R. and Peterson, E.B. *Northern Land Use Law and Policy Development: 1972-1978 and the Future.* Canadian Arctic Resources Committee (46 Elgin St., Ottawa, K1P 5K6), February 1978. 99 pp.

Annotated in 5.5 Environmental Impact Assessment.

Mandelker, Daniel R. *Environmental and Land Controls Legislation.* Indianapolis: Bobbs-Merrill Co., 1976. Hardcover, 417 pp. $15.50.

McCullough, Sandra G. et al. *A Handbook of Considerations for the Environmental Review Process.* Broome County Dept. of Planning (County Office Bldg., Government Plaza, P.O. Box 1766, Binghamton, NY 13902), 1977. 104 pp.

The purpose of this book is "to provide participants in the land development process with a framework by which environmental criteria can be incorporated into the desision-making process". Five chapters cover land, air quality, water, noise and social considerations. In each (with respect to general, residential, commercial and industrial criteria) a set of questions is set out for the review body to have answered when making an environmental appraisal of a development proposal. Under each question is the reason for the query, e.g.:

> *Will there be any adverse effects on vegetation as a result of the heavier vehicles and transportation networks necessary for commericial development and industrial activity?*
>
> *Air pollution from truck exhaust and increased amounts of salt necessary for winter road clearing can have a critical impact on vegetation along roadways.*

Metropolitan Dade County Planning Department. *Proposed Environmental Protection Guide for Metropolitan Dade County: Part 2 of the Comprehensive Development Master Plan.* The Department (1351 N.W. 12th St., Miami, Florida), June 1974. 181 pp.

Provides detailed guidelines (performance standards) for use in evaluating the environmental effects of different types and intensities of urban development and describes the background environmental information upon which the guidelines are based.

Ontario Ministry of Housing. *Rural Estate Guidelines.* Toronto: The Ministry, Plans Administration Division, 1977. 32 pp. Available from Ontario Government Bookstore (880 Bay St., Toronto M7A 1N8), $1.00, cheque payable to Treasurer of Ontario.

"Rural Estate" refers to planned low-density non-farm residential development in a rural area. These guidelines are intended to provide municipal planners and consultants with criteria for formulating planning policies for rural estate development. They cover physical, social and economic concerns as well as implementation.

Ontario Ministry of Energy. *Perspectives an Access to Sunlight.* The Ministry (56 Wellesley St. W., Toronto M7A 2B7), May 1978. 90 pp. Free.

An urban solar user in Ontario is generally unable to obtain legally secure access to sunlight. This paper aims at stimulating discussion about solar access and its potential impact on land use considering the needs of solar users and the legitimate expectations of their neighbours. It outlines the existing law on access to sunlight in Ontario under the categories of nuisance, easements, covenants, airspace and trespass. Ontario law does not protect solar access for most urban landowners since there is no automatic right to light which crosses the property of others. A landowner is entitled only to prevent obstruction of the airspace vertically above his property. The erection of new buildings is generally considered more important than the competing desire for unobstructed light and air. The paper reviews several potential mechanisms for protecting solar access: private agreement, doctrine of ancient lights (abolished in Ontario in 1880), restrictive covenants, solar zoning (defining zones in which solar use is encouraged, and passing shade control by-laws) and certification of solar rights by municipal permit.

Ontario Ministry of Treasury, Economics and Intergovernmental Affairs. *Government Policy for the Niagara Escarpment.* TEIGA (Queen's Park, Toronto M7A 1Y7), 1973. 35 pp. Contact Niagara Escarpment Commission (232 Guelph St., Georgetown, Ont. L7G 4B1).

Osterhoff, A.H. et al. *Restrictions on the Property Right in Ontario.* Ontario Real Estate Association (99 Duncan Hill Road, Don Mills, Ont.), 1973. Paperback, 65 pp.

The common law rights of property ownership include the right of possessing (up to the sky and down to the centre of the earth), of excluding others, of disposition, of using, of enjoying the fruits and profits of land, and of destroying or injuring property. Environmentalists may be surprised and disturbed to know that a landowner has the exclusive right to hunt, trap or otherwise appropriate the wild animals found on his land. The report goes on to describe the various restrictions which limit exercise of these rights.

Pease, James R. *Bibliography of Performance Standards for Land Use Planning.* Council of Planning Librarians (Box 229, Monticello, IL 61856), CPL #962, January 1976. 6 pp. $1.50.

Unfortunately, not annotated and addresses/prices not given. See also, from the Oregon State University Extension Service (Corvallis, Oregon): James Pease and John Stockham, *New Land Use Control Techniques: A Summary Review and Bibliography*, June 1974; Pease, *Report #7: Guidelines for Using the Performance Planning Approach*, September 1974; and Stockham and Pease, *Report #8: Implementing the Performance Planning Approach*, Sept. 1974.

Rahenkamp, John, Ditmer, Robert W. and Ruggles, Donald, "Impact Zoning: A Technique for Responsible Land Use Management", *Plan Canada*, 17/1, March 1977, pp. 48-58.

Opens by critizing land use controls that use standards that are often arbritary and legally indefensible, that ignore the inevitability of change and that overemphasize causes rather than effects. Impact zoning at-

tempts to address these issues by establishing "a process for evaluating the relationship between a community's available capacities and the demands upon community systems created by a proposed land use". The authors (Rahenkamp invented impact zoning) explain its underlying philosophy and application, so far limited to U.S. cases (where it has encountered trouble in the courts). See also: Burchell and Listokin, above; Ditmer, above; and Natalie Gerardi, "The Town that Said No to No-Growth", *House and Home*, Vol. 44, No. 6, December 1973, pp. 62-69. An example of application is Adley Associates, *Cocoa Beach, Florida: Impact Zoning Procedures, An Element of a Growth Management Program* (City of Cocoa Beach, Florida, 1976), $5.00

Reilly, William K. (ed.). *The Use of Land: A Citizen's Policy Guide to Urban Growth.* New York: Thomas Y. Crowell Co., 1973. Paperback, 318 pp. $3.95.

The Task Force that prepared this book concluded:

> *We think it highly likely that in forthcoming decades Americans will gradually abandon the traditional assumption that urbanization rights arise from the land itself. Development potential, on any land and in any community, results largely from the actions of society (especially the construction of public facilities). Other free societies, notably Great Britain, have abandoned the old assumption in their legal systems and now treat development rights as created and allocated to the land by society.*

Chapter IV discusses "adapting old laws to new values". Chapter V, "Creating What We Want: Regulating Development", reviews options for regulating land at the local level with special emphasis on environmental impact analysis and local development review. Annotated further in 2.3 Land Use and Misuse.

Richardson, D.K. *The Cost of Environmental Protection.* New Brunswick, NJ: Rutgers University, 1976. Hardcover. $10.00.

Rogers, I. MacF. *Canadian Law of Planning and Zoning.* Agincourt, Ont.: Carswell Co. Ltd., 1973. Loose-leaf format with updates. Loose-leaf plus Release 5, $50.00. Release 5, $16.00.

Rivkin, Malcolm D. *Negotiated Development: A Breakthrough in Environmental Controversies.* The Conservation Foundation (1717 Massachusetts Ave. NW, Washington, DC 20036), 1977. 23 pp.

Annotated in 5.6 Organizational Arrangements.

Schaenman, Philip S. *Using an Impact Measurement System to Evaluate Land Development.* Urban Institute (2100 M St. NW, Washington, DC 20037), September 1976. 106 pp. $3.95

A systematic approach toward measuring impacts of land development at the local level is needed because current approaches lack comprehensiveness, consistency and clarity. This report assumes that better decisions can be made if the various parties involved in land use decisions have a clear understanding of the likely impacts of development. It devises and reports the results of tests of a set of impact objectives and key community concerns. See also Keyes in 5.5 Environmental Impact Assessment.

SCS Engineers. *Sewer Moratoria: Causes, Effects, Alternatives.* U.S. Dept. of Housing and Urban Development, Office of Policy Development and Research (Washington, DC 20410), 1978. 153 pp.

A moratorium happens when a regulatory action temporarily limits housing construction in an area because the wastewater treatment or collection facilities are inadequate. This "guidebook" discusses the basis of wastewater management, causes and characteristics of moratoria, their impacts, measures to reduce these impacts, advance planning for wastewater management, and treatment processes and small treatment plants.

Solomon, Arthur P. *The Effect of Land Use and Environmental Controls on Housing: A Review.* Joint Center for Urban Studies of the Massachusetts Institute of Technology and Harvard University, 1976. 31 pp.

Concludes, "Public regulations that reduce the supply available for development will give rise to higher land and housing costs. While existing studies indicate that the environmental reviews in themselves have a small impact on housing costs, other growth controls such as sewer moratoria, building permit ceilings and development timing ordinances appear to significantly increase land and housing costs in areas available for development."

Thurow, Charles, Toner, William and Erley, Duncan. *Performance Controls for Sensitive Lands: A Practical Guide for Local Administrators. Parts 1 and 2.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), P.A.S. No. 307 and 308, 1975. 156 pp. $12.00.

Annotated in 3.6 Environmentally Sensitive Areas, this report identifies the key natural processes of five environmentally sensitive areas which provide important public benefits – streams and creeks, aquifers, wetlands, woodlands and hillsides – and suggests means by which these benefits can be maintained using the basic regulatory powers available to local governments in the United States. Emphasis switches from designating required uses of land to maintaining natural processes using performance requirements. The authors argue that the design and implementation of the ordinances they describe (ordinances for erosion and runoff, watercourse protection, floodplain, soil conservation, aquifer recharge, shoreline management, trees, hillside preservation, etc.) are well within the capabilities of local government. Critical factors in developing sound ordinances are: analyzing the natural processes; identifying and mapping sensitive areas to be protected; and devising the necessary legal language, especially in relation to the "taking" issue.

Todd, Eric C.E. *The Law of Expropriation and Compensation in Canada.* Agincourt, Ont.: Carswell Co. Ltd., 1976. Hardcover, 472 pp. $47.50.

Urban Systems Research and Engineering, Inc. *The Growth Shapers: The Land Use Impacts of Infrastructure Investments.* Washington, DC: Council on Environmental Quality, 1976. 21 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 041-011-00029-7, $1.30 + 25% outside U.S.A.

Annotated in 4.2 Urbanization. Other sources on this subject include: S.E. Bascom et al., *Secondary Impacts of Transportation and Wastewater Investments* (U.S. Dept. of the Interior, 1975), annotated in 4.5 Transportation; New Jersey Dept. of Community Affairs, *Secondary Impact of Regional Sewerage Systems* (Division of State and Regional Planning, 329 West State St., Trenton, NJ 08625); and Peter H. Gulberg et al., "Secondary Impacts of Major Land Use Projects", *Journal of the American Institute of Planners*, July 1977, pp. 26-270.

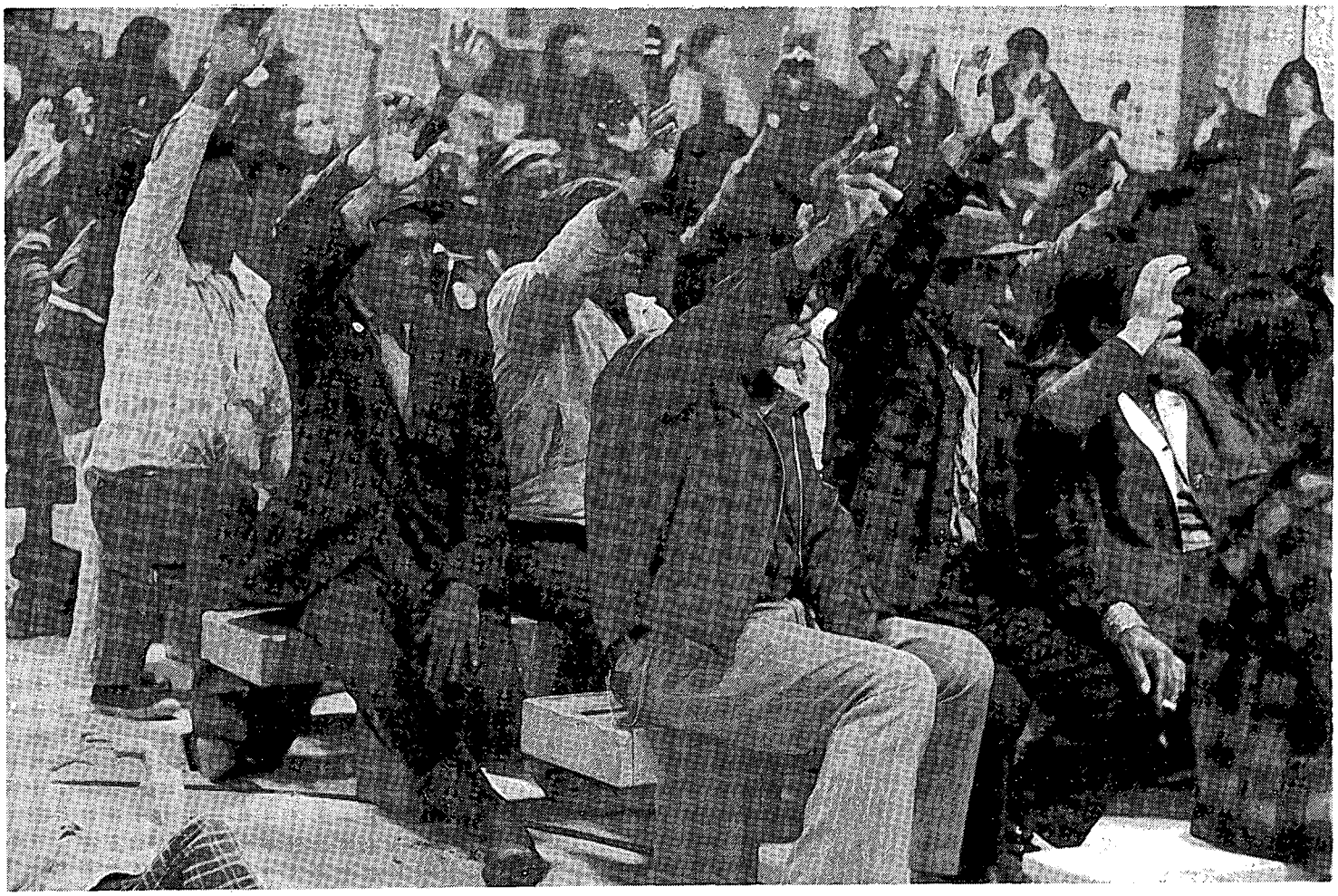
Wickersham, Kirk et al. *A Land Use Decision Methodology for Environmental Control.* Washington, DC: U.S. Environmental Protection Agency, 1975. Paperback. 18 pp. Available from National Technical Information Service (5285 Port Royal Rd., Springfield, VA 22161).

Annotated in 1.3 Characteristics of Environmental Planning.

5.8 Public Participation

A prominent feature of public and corporate life in the last decade has been a demand by people for more participation in decisions directly affecting the quality of their lives and their environments, along with a growing unwillingness to let outside actions detract from that quality. This deep-rooted trend extends across society, from churches to prisons, in the workplace and the home, from public housing projects to university campuses. Whether decision processes have become more open and accessible as a result can be debated but the pressure to respond to demands for public participation is undeniable.

Environmental problems have potential for precipitating conflict among interest groups. They require individuals to choose a new balance among their preferences and they reveal maldistribution of the goods and bads. And they often generate, and create demands for, the active participation of concerned publics. Numerous examples of responses to such demands exist: the Berger Inquiry in the Mackenzie Valley and Western Arctic and the Hartt Commission in northern Ontario; Saskatchewan's Cluff Lake Inquiry; various hearings of the federal Environmental Assessment and Review Process, the National Energy Board, Ontario's Environmental Assessment Board and similar agencies; Alberta's Land Use Forum; Prince Edward Island's Royal Commission on Land Ownership and Land Use; and countless public meetings at local and regional levels across the country.



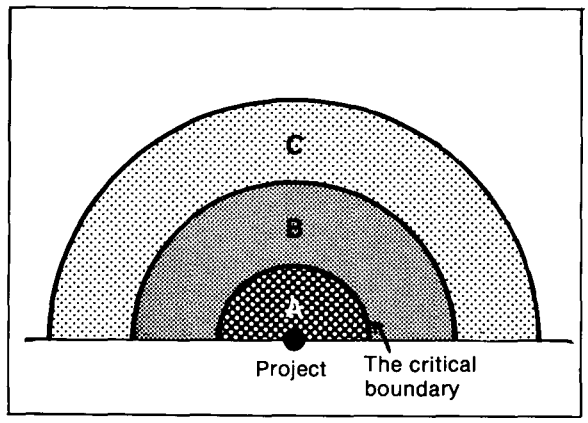
Public participation in planning and decision processes is more than merely response to demand, however. It is also pursued for certain benefits it promises, including:

- Data (especially qualitative) on goals, attitudes, values, preferences and priorities from those to be directly affected by proposed actions; their knowledge gained from experience living in the area; and a better chance of getting at the real problems.
- A hedge against later criticism that insufficient opportunities to participate were offered (those not involved may assume they were deliberately kept uninvolved); increasing the likelihood of the plan being accepted and implemented; and easing the way for necessary behavioural changes.
- More open and responsive planning and administrative decisions; less distance between governors and governed; and a better understanding of the needs and values at work in public decisions.
- Greater political awareness, more responsible citizens, more opportunity for people to contribute constructively to betterment of their communities.
- And generally, strengthened democracy resulting from a better informed, more involved citizenry.

The promises are not always fulfilled. Increasing the number of actors in a decision process: adds to the uncertainty, multipying chances of disagreement perhaps even conflict; raises difficult questions such as who speaks for whom and produces confusion between elected representatives and community groups; often highlights the views of those who are opposed to a course of action, out of proportion to their numbers; tends to prolong debate and defer, perhaps even block, action; consumes resources; and provides ideal opportunities, biased toward the haves and against the have-nots, for narrow vested interests to be advanced under the guise of a Good Thing.

Part of the problem with public participation is the lack of consensus on what it is, why it is needed, what purposes it should serve and what it ought to accomplish. Some see an active enlightened citizenry as the appropriate democratic ideal. Others worry about too much participation upsetting social stability and order. Still others believe liberal democracy to be inherently manipulative and elitist; to them no meaningful participation is possible without basic redistribution and decentralization of power. Differing definitions and approaches to public participation reflect this diversity of views.

Selecting a position on public participation will be partly the planner's personal choice and partly determined by the organizational/political/cultural context. The planner is aware that not every citizen wants to get involved entirely in every issue or at every level of planning from site to region. Some people will be satisfied to limit their participation to the electoral process; others will want to be kept informed of matters affecting them, with opportunities to get actively involved if they so wish; a few will desire in-depth involvement on many issues. A given project affecting a specific site is more likely to attract people, whose interests are thereby directly engaged, than an area-wide or regional plan (which is one reason why environmental impact assessment can be a useful participative tool). Matching participation programs to the scale of planning and the level of desired involvement helps keep public and planners' expectations realistic.



Zone	Benefit/Cost Distribution	Likely Attitude to Project
A	Economic benefits outweighed by economic costs (e.g., dislocation), loss of environmental quality, etc.	Against
B	Far enough away to escape many of the foregoing disadvantages but near enough to enjoy the benefits	For
C	Far enough away to experience neither costs nor benefits directly. Attitudes toward project based more on pre-determined values (e.g., pro-or anti-nuclear) than on its merits	Both for and against

Figure 5.12

Opposition/Support and Proximity to the Project.

Four broad approaches to participation can be identified (adapted from Bregha):

Information-Feedback: giving people information on their environment and changes

Table 5.4 Information-Feedback Techniques

Technique	Description	Advantages	Disadvantages
Media	Techniques to assist in describing the project	Helps to visualize and relate to the form of the housing	Models — Can be used to give a distorted view of the project
1. Visualize Aids Slides Models	Purpose — to aid understanding	Shows how the housing project fits into neighbourhood context and demonstrates its possible impact Models put in public places help to promote program	Slides — Require useful commentary and good organization to be effective
2. Exhibits Films Tape presentations	Brief pictorial presentation of the program and specific projects Purpose: create awareness and inform	Very useful for generating interest and discussion Can reach a wide number of people if used in open-house setting	May be expensive initially
3. Information kits	Folder or binder with basic information on one agency, planning concepts, methods, municipal government procedures	Provides useful background information Can be sent out to various organizations and groups and put in libraries to reach a wide audience	No feed-back Best used with other techniques
4. Newspaper reports	Articles in local papers discussing the project Purpose — to inform	Inform a wider audience May interest people in becoming involved May give favourable publicity to the agency	May not give an objective view May be used to raise other issues or objections to the project May result in unfavourable publicity
5. Tours of existing projects and meetings with tenants	Field trip to the site of existing or potential projects Purpose — provides an opportunity to see the program in operation	Allows people to make their own judgments about the program Answers questions about management and operations Gives an 'insiders' view as a balance to the community's perspective	Tenants should be able to relate well to working committee members May raise misleading expectations about new projects Time consuming
6. Newsletters	Regular publications from the local association Purpose — to keep residents informed	Keep area residents informed and up-to-date	May not be objective — may misinform May be used in place of other meetings
7. Open Letters	Correspondence from aldermen or commissioner concerning an issue Purpose — to give progress report or present another side to an issue	May fill communication gap if residents are not kept informed. through other means	May raise more questions than it answers Allows no feedback Occurs usually in response to a crisis. More open communication would eliminate the need for this response

Source: Diana Collins, "A View From the Other Side: Citizens Participate in Planning Urban Housing", *Urban Forum*, Vol. 3, No. 5, Jan.–Feb. 1978.

proposed to it, and seeking responses from them. Two kinds of information can be identified: *processed*, from statistics, studies and books, and *personal*, from first-hand experience with the environment in question (Friedmann). Planners usually have a lot of the first kind but little of the second while for citizens it is the other way around. Both kinds of information are valid. If that is conceded, planners and citizens working together can learn from each other.

Consultation. Information-feedback can be a valuable approach but it restricts affected interests to a reactive position. Consultation means planners and other officials meeting with individuals and groups in an organized way for the purpose of increasing participation in planning and decision-making. Consultation is particularly important when the issue is perceived differently from the standpoint of the implementing agency (for example, the municipality) than from the standpoint of the citizen. This frequently occurs where government plans, taking an area-wide perspective aimed at the larger "public good", contrast with the views of the particular area whose residents bear the brunt of the cost. Careful design of consultation processes is necessary to identify the areas of disagreement and differing value priorities as the basis for seeking consensus on appropriate courses of action. Alternative means to resolve the conflicts may be required; environmental mediation (see Baur) is one promising direction.

The public hearing is a technique much used in environmental planning for both information-feedback and consultation purposes. Its value depends on recognition of its limitations. Hearings conducted in an adversary style with lawyers assuming the main roles may be justified in some circumstances but they severely limit public participation and information exchange. Conversely, there is considerable participative potential in hearing processes preceded by efforts to provide the local area with necessary information about their community and proposed changes, especially if their education is conducted in an open informal atmosphere. A critical factor in both cases is the extent to which the advice of the hearing panel or officer will be binding upon or influential with the ultimate decision-makers.

Joint Planning. Consultation involves reaching out for public input to a planning process still largely under the initiating agency's control. Joint planning goes a step further. Citizen and other interest groups on the one hand and planners and officials on the other become partners in designing the planning process, formulating the plan and solving problems that arise along the way; final decisions on adopting and implementing the plan remain with others. The promise is higher-quality guidance to the initiating agency, and better odds on reaching an acceptable, effective plan. The risks centre on the uncertain outcome and the time involved. Compared with the earlier approaches, greater attention is required to making the joint body representative, providing it with linkages to other interests and to implementing agencies, redefining the conventional planning style (from planning *for* citizens to planning *with* them) and setting realistic constraints (including time) on the planning process.

Delegated Authority: transferring some or all of the authority and responsibility of the initiating agency, whether government or private developer, to citizen-controlled groups to conduct the planning and/or undertake management. Delegated authority applies to local situations with a significant amount of self-help involved, where appropriate expertise is available, where administration can be entrusted to an organized responsible group of users, where openness can be ensured and accountability clearly established, and where performance can be regularly evaluated. Management could range from a citizen-controlled organization charged with monitoring environmental effects, to operation of facilities and services. The promise of delegated authority is that by returning responsibility to those directly affected, the initiating agency may be relieved of some of the pressure to provide an increasing array of services. The concern is that the delegated authority will somehow be misused and (implicitly) that wide use of this approach would weaken government as an institution.

The foregoing approaches are based on a pluralistic model of society. Their principal weakness is the model's assumption that interests are equal in their ability to identify and take advantage of participative opportunities. Significant interests – for example, disadvantaged minorities, consumers who are not adequately organized, and future generations – are unable to ex-

Table 5.5 Consultation Techniques

Technique	Description	Advantages	Disadvantages
1. Meetings Public Meetings	Meeting open to all area residents Purpose — to present program and determine its impact	Provides an opportunity to inform citizens about the program Provides interested people with a chance to become more involved Is most useful if used in conjunction with other forums to allow more direct exchanges	Only attracts the few with sufficient time and interest to come Does not ensure that all views will be heard Does not allow for on-going feedback Inhibits two way communication May become a forum for other issues and would-be politicians
2. Open House	Day long display of information and proposals Purpose: to introduce the neighbourhood to the project and to planners	Allows two way communication Avoids issue confrontation Provides wide range of information Timing can allow wide participation Informal atmosphere encourages questions and feed-back	Time consuming Expensive in terms of staff time

Source: Diana Collins, "A View From the Other Side: Citizens Participate in Planning Urban Housing", *Urban Forum*, Vol. 3, No. 5, Jan.–Feb. 1978.

Table 5.6 Joint Planning Techniques

Technique	Description	Advantages	Disadvantages
1. Working Committee (may include site office)	Formally appointed/elected representative citizen group Purpose — to sensitize planners and citizens to project impacts and to design project in accordance with neighbourhood concerns	Provides opportunity for two way communication with a representative body Reduces need for public meetings Assists in gaining support Provides indepth information on issues Opens channels to other City Hall departments May help resolve wider community issues Speeds up rezoning procedure Provides for direct interaction between citizens and planners — may alter stereotypes Involvement of experts and consultants provides indepth information	Members may not represent all views Role of committee may be seen by public as a decision making body and by agencies advisory Residents may raise unrelated issues which may stall development Divisions may result among people with different aims The aim for concensus may lead to unsatisfying compromises Community concerns may take precedence over the needs of future tenants
2. Workshops	Working sessions in which interested people can discuss specific issues	Allows participants to work out value priorities and evaluate alternatives	Requires careful preparation and experienced leaders.

Source: Diana Collins, "A View From the Other Side: Citizens Participate in Planning Urban Housing", *Urban Forum*, Vol. 3, No. 5, Jan.–Feb. 1978.

For various reasons, the traditional common law court action, initiated by an aggrieved private citizen, is just not a feasible environmental strategy in Canada. Nor is the private prosecution . . . no matter what the local variations. Legislative frameworks in various jurisdictions give immense, undefined discretion to politicians and bureaucrats on environmental matters, while at the same time consistently excluding citizens from direct input in the process . . .

. . . obvious ways to dampen participation are to limit time available for the presentation, to refuse to release the relevant material, to require written submissions in multiple copies as a condition of being heard in person, to have a very formal court-like procedure with lawyers and cross-examination, and so forth . . .

As K.C. Davis has written, "Openness is the natural enemy of arbitrariness and a natural ally in the fight against injustice".

P.S. Elder.

ercise influence; the very nature of the society may create and maintain their under-represented position (see Friedenberg, annotated in 1.2 Characteristics of Environmental Problems). Community organizing, to mobilize unrepresented interests and help them gain the resources necessary for effective participation, rarely accompanies planning processes.

Other problems that affect most interests seeking to participate, and that become factors in deciding which participative approach to use, include: low level of commitment to real participation by elected and appointed decision-makers; inability of institutions to respond to the outcome of participative exercises (narrow policies and programs that cannot handle the variety thus generated); decision processes well advanced when participation begins, which means few remaining decisions amenable to influence; the controversial nature of certain issues, such as an industry rumoured to be dangerously polluting, a project which raises significant job/environment conflicts in a depressed area, or a proposal that appears to discriminate against a particular group; and the capability of the receiving area to cope with the planning process. Capability includes: access to information (Canada lacks freedom of information laws common in the United States, although various investigations along this line are underway); technical and professional expertise under citizen control and advocating local interests; organizational and adminstrative support especially in getting started; time to study and respond to proposed interventions; and money for these and related purposes. Funding for citizen "intervenors" in environmentally oriented participation processes has been provided in recent large-scale exercises (examples are the Mackenzie Valley Pipeline Inquiry, Royal Commission on the Northern Environment and Royal Commission on Electric Power Planning in Ontario, and Cluff Lake Inquiry in Saskatchewan) but this approach is strongly resisted. To those who view government as "the people" rather than as one interest among others, financially assisting 'vested interests' to oppose projects aimed at the larger good is not only senseless but basically wrong.

Other concerns raised by public participation include:

Representation. "Who do these citizens represent?" is an often-heard and valid question that can also be used to discredit a participating group. It may not be possible to determine representation clearly and assure total accountability of citizen representatives, just as it is often difficult to determine who elected politicians represent – they may have been elected with a small plurality and their mobile electorate may be quite different from the group on election day – and to be clear on what issues they do and don't represent us. Participation will work better if these questions are openly acknowledged as fuzzy, and if it is recognized that the alternative may be no participation at all.

Larger vs. local interests. Some may feel public participation threatens the government's ability to take action in service of a majority without being blocked at every turn by self-interested parochialism. Frustrated attempts to locate garbage disposal facilities in and near various urban centres provide a topical example. Larger/local interest "bargains", often struck only implicitly in the past, are being re-opened and re-examined today whether participative planning occurs or not. It can be expected that individual communities or interests will do everything possible to maximize their environmental quality and minimize unwanted intrusions; certain parts of every human settlement have been doing that successfully all along. Being examined here are deep issues of equity which will not be avoided merely by short-cutting participation. On the other hand, open and informed participative processes that demonstrate the aggregated consequences of individual actions may challenge fundamental underlying contradictions between an environmentally destructive high-consumption lifestyle and the implicit "right" of everyone to a healthful quality environment.

Loss of power. Concern often exists that public participation will erode the power of elected representatives to the benefit of non-elected groups. This view sees power as a fixed amount; one's gain is another's loss. In fact there are various types of power, exercised in various ways. Public participation works toward influence more than power – some see that as its weakness – in an attempt to bring new information and perspectives to decisions made by those elected for that purpose. The key issue is less a matter of power than how to turn the social energies released by public participation toward constructive ends.

Getting things done. Officials under pressure to produce efficiently within deadlines are understandably concerned that public participation will create delays and obstruct action. Longer planning periods and less-smooth operations – bearing in mind that it may be impossible to determine how long planning would have taken *without* public participation – may be tradeoffs accepted in exchange for gaining the benefits of participation and avoiding of the costs of non-participation. Time and efficiency are not the only important criteria, however. Often the real concern may be the accompanying open operation which exposes error (plus dubious data, superficial planning or sloppy management) and produces criticism. The *quid pro quo* of public participation that citizens should be asked to acknowledge at the start is that if governments or private firms are expected to operate more openly, the public can be expected to accept the inevitability of error and tolerate mistakes. People have to expect less to be involved more.

Responding effectively. Demands for public participation give planners an immediate problem: determining what kind of participation program to create, for what purposes and how. Bousfield, reviewing public participation in municipal planning in Ontario, concluded that the shortcoming of participation programs had two principal causes: the planners and politicians failed to consider what participation was meant to achieve and to design programs accordingly; and the planners, politicians and public lacked experience in participative planning. The most essential characteristic of a successful program, he decided, is the ability to respond swiftly and flexibly to unforeseen concerns raised by the public. It is also essential for the planner to maintain flexible expectations. Bousfield notes, "It came as a profound shock to many planners that the public's attention, which they had long sought to attract, manifested itself in vehement opposition to almost everything the planners had held to be sacred".

Costs. Public participation may cost more money; how much can only be learned by experience with specific environments, activities and institutional/cultural settings. It will also yield benefits, some of them tangible in cost terms (e.g. not having to build an expensive facility, reduced public demands for services, co-opted citizen labour). Avoidance of costly errors is an added potential benefit; an example is offered by budworm spraying in B.C. which was delayed by public concern and turned out to be unnecessary.

For the environmental planner/manager, public participation raises three additional considerations:

1. *Managing the variety generated.* The institutional component of complex environmental problems characterized by numerous fragmented *effecting* jurisdictions, also typically includes numerous conflicting *affected* interests. Environmental planning/management strategies require an approach that explicitly addresses, then reduces, this complexity in order that integrated courses of action may be devised. Public participation, therefore, must be undertaken carefully to ensure that it contributes to the solution of, rather than adding to, the uncertainty problem.

2. *Generating demand and support.* Decision-makers, especially politicians, respond to perceived demand and support. Public participation is essential in environmental planning to reveal, and more often to mobilize, public demand for an support of environmental initiatives. If this cannot be done, environmental considerations are likely to be seen as low in priority and they will lose out in the political trade-off process. A provincial Minister of the Environment recently warned, "The environment must become a priority for the people before it can become a priority for any government".

3. *Promoting a learning process.* The need for environmental planning and management results from the undervaluing of environmental things, both privately and publicly. If, through a participation program, people are asked directly for their views on a proposed pro-environment initiative, as opposed to using available resources (money) elsewhere, the danger is that they will choose the latter (although public opinion surveys have revealed a general public desire to pay more in return for higher-quality environments). Should the planners be committed in advance to incorporating these public views in their plans, such participation could be disastrous from an environmental perspective. For that reason, the participative component of environmental planning has to be deliberately set up, first to test public opinion on environmental issues and then, if required, to initiate a

learning process in which various interests alter their perceptions of environmental resources. This may occur through: (a) gradual exposure to information about these resources, the work they do for man, what their loss could mean and cost, and what the individual and collective consequences of human activity on them are; and (b) responsible involvement in choices and the associated environmental trade offs. In other words, participation in environmental planning begins with a determination of what the public's environmental values are (e.g. attitude surveys) and examination of past decisions that reveal environmental values during tradeoffs) as the basis for designing the rest of the planning program. Information about environmental resources may have to be fed back through several participative cycles involving ever-more specific planning proposals. Individuals and collectivities whose values conflict sharply with environmental interests will require special treatment. Efforts may be needed to avoid actions (such as premature release of a plan) which would coalesce these interests or cause them to be linked up with widely felt concern over threats to the prevailing lifestyle. If that happens, the environmental cause in that area may be set back for some time.

Diffusion of an environmental perspective and alteration of certain behaviour typically goes through a process that involves: 1. an early stage of increased *awareness*, 2. subsequent *interest*, 3. *evaluation*, followed by 4. *trial*, eventually leading to 5. *adoption* (Nix). Pro-environmental individuals will already be convinced. Influencing a sizable number of the remainder necessitates their active involvment in the planning process. Consensus building, mobilizing interests and constant reality-testing (Etzioni) are likely to be prominent features of such a process. Technical approaches to environmental planning – focusing on environments to the exclusion of institutions – used alone are inadequate, given the typical undervaluing of environmental considerations in the decisions that follow plan-making. Such approaches may even be counter-productive if they turn people off, appear manipulative or try to maintain as technical what is essentially a qualitative process. Similarily, reliance cannot be placed on coercion to achieve necessary environmental change. Coercion will be needed from time to time (e.g. regulations prohibiting non-disposable containers) but its applicability is limited for environmental purposes. Even if the will to coerce is present and its use is deemed acceptable, the means would not exist, given the pervasiveness of environmental considerations and the fragmentation of implementing jurisdictions.

The remaining alternative is a planning/management approach that seeks to alter behaviour through active participation of affected (and effecting) interests in an explicit learning process.

Six Simple Techniques for Avoiding Action
(adapted from Solnit, 1974)

1. For every proposal set up an opposite, then concede to a middle ground (no action at all).
2. Ask what is meant by the question (by the time it's explained to everyone's satisfaction, it's time to go home).
3. Profess not to have the answer (this lets you out of having any answer at all) while earnestly cautioning against proceeding rapidly (which helps avoid proceeding at all).
4. Emphasize righteously, "This problem cannot be separated from other related problems" (translated this means we can't solve this problem until we've solved all related problems – which means never).
5. Warn the gathering, "We'd better wait until we can consult an expert". Or, as an equally effective action-stopper, propose appointing a committee.
6. In closing, be sure to congratulate the problem: "It certainly has stimulated discussion, contributed to growth, opened new vistas and shown us the way". (We've wasted two perfectly good hours but that problem surely deserves a medal).

Case Study 99
A Layman's Guide to Urban Natural Areas

Responding to the initiative of the Toronto Field Naturalists Club, 15 professors at the University of Toronto and three other specialists are compiling, *Investigating and Preserving Urban Natural Areas: A Guide for the Lay Person.* The objective is to produce a handbook, geared to the needs of interested laypersons, which will give them a grasp of (a) the principles and methods involved in making sound studies of environmental issues affecting natural areas, and (b) the most effective ways of presenting their findings to governments, public hearings and others. The handbook will include:

- Introductory material on urban natural systems.
- Five chapters on how to organize a natural-area study according to subsystems (geophysical factors, vegetation, wildlife, fish, insects) and how to write up the data.
- Five chapters covering human interaction with natural systems in urbanizing environments (planning, environmental impact, politics, environmental law, environmental awareness/education, urban natural systems in transition).
- A final chapter on where to get further help.

Professor William A. Andrews, Faculty of Education University of Toronto, is the editor of the handbook. For examples of similar works, see Ashton (Information Resources).

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Information Resources

See also:
1.2 Characteristics of Environmental Problems
5.2 Information

Anderson, G., "Local Area Planning: The Dream and the Reality", *City Magazine*, March 1977.

Overviews the experience of planners working directly with citizens in site offices in various Canadian cities.

Arnstein, Sherry, "A Ladder of Citizen Participation", *Journal of the American Institute of Planners*, Vol. 35, No. 4, July 1969, pp. 216-224.

The author, in this influential article, identifies an eight-rung ladder comprising three types of citizen participation: non-participation (manipulation, therapy); tokenisim (informing, consulation, placation); and citizen power (partnership, delegated power, citizen control). Her values implicitly favour the top level.

Ashton, James. *Natural Resources Inventory: A Training Program for Citizen Conservationists.* Farm and Home Center, Community Resource Development (P.O. Box 259, Millbrook, NY 12545), 1972. Paperback, 56 pp.

Annotated in 5.2 Information which lists other citizen-oriented references on assembling data bases for environmental planning.

Baur, E. Jackson, "Mediating Environmental Disputes", *Western Sociological Review*, Vol. 8, No. 1, 1977, pp. 16-24.

Increasing public concern over the environmental consequences of development projects has created a need for effective ways to resolve conflicts among involved interest groups and agencies. Direct action and litigation can be excessively time-consuming and costly for all sides. Conventional conflict resolution theory, institutionalized in labour-management relations, seems inappropriate to such cases. The University of Washington's Office of Environmental Mediation demonstrated in the Snoqualmie River controversy, however, that the mediation process can be successfully applied to certain environmental situations. Intervenors went beyond the mediator role to also act as community organizers and change agents. Existing models of conflict resolution need to be revised to accommodate the dynamic of environmental controversies, the author concludes. See also: G.W. Cormick, "Mediating Environmental Controversies: Perspectives and First Experience", *The Earth Law Journal*, April 1976, 18 pp., available from the Office of Environmenal Mediation, Institute for Environmental Studies, University of Washington (Seattle, Wash. 97195). Another source, on a different kind of project, is Malcom D. Rivkin, *Negotiated Development: A Breakthrough in Environmental Controversies* (Washington: The Conservation Foundation, 1977), annotated in 5.6 Organizational Arrangements. The Council on Environmental Quality (722 Jackson Place NW, Washington, DC 20006) is producing "a handbook describing the kinds of disputes that are most suitable for environmental mediation".

Bolan, Richard S., "Community Decision Behavior: The Culture of Planning", *Journal of the American Institute of Planners*, Sept. 1969, pp. 302-310.

The author provides a conceptual framework for the process of public participation, from a planner's perspective.

Bousfield, John Associates, *Citizen Participation in the Preparation of Municipal Plans.* Toronto: Ontario Planning Act Review Committee, Background Paper 4, 1977. 49 pp. Available from Government of Ontario Bookstore (880 Bay St., Toronto M7A 1N8), $1.00, cheque payable to Treasurer of Ontario.

Based on interviews with planning directors and senior planning staff in selected Ontario municipalities, this study analyzes the objectives, methods and effectiveness of public participation programs, then looks at citizen involvement from a wider perspective of civic affairs over the past decade.

Bregha, Francis. *Public Participation in Planning Policies and Programmes.* Ontario Ministry of Community and Social Services (80 Grosvenor St., Toronto M7A 1E9), n.d. Free.

Bureau of Municipal Research. *Citizen Participation in Metro Toronto: Climate for Cooperation?* BMR (2 Toronto St., Suite 306, Toronto M5C 2B6), Jan. 1975, 68 pp. $2.00.

Discusses meanings of "citizen participation", settling on "a component of the democratic system which permits non-elected members of the community to exercise some control over decision-making which goes beyond elections". Citizen activism in Toronto and North York since 1966 is examined along with methods of citizen participation and attitudes of officials and committed citizens toward participation (these differed markedly between the two adjoining municipalities).

Caldwell, Lynton K et al. *Citizens and the Environment: Casè Studies in Popular Action.* Bloomington, IN: Indiana University Press, 1976. Paperback, $6.95.

Discusses 68 cases in which environmental groups have come into conflict with government, industry and other power blocs.

Canadian Environmental Law Association. *Waging a Campaign* CELA (One Spadina Crescent, Suite 303, Toronto M5S 2J5), n.d. Availability uncertain.

Describes ways other than legal action to mount a successful campaign to protect the environment. See also "How to Wage a Campaign: The Canborough Success

Story", Chapter 5 of David Estrin and John Swaigen, *Environment on Trial: A Handbook of Ontario Environmental Law* (CELA, 1978), annotated in 5.7 Regulation and Review. Similar sources are: Anthony Jay, *The Householder's Guide to Community Defence Against Bureaucratic Aggression* (London: Jonathan Cape, 1972); Andrew J. Roman, *Guidebook on How to Prepare Cases for Administrative Tribunals* (Consumers Association of Canada, 251 Laurier Ave. W., Room 801, Ottawa K1P 5Z7) Feb. 1977; James Robertson and John Lewallan (eds.), *The Grass Roots Primer* (San Francisco: Sierra Club Books, 1975); and Joan Flanagan, *The Grass Roots Fundraising Group: How to Raise Money in Your Community* (Chicago: Swallow Press, 1977).

Capital District Regional Planning Commission. *A-95 Project Notification and Review System: Procedures Guide for Applicants in the Capital District Region.* The Commission (Stuyvesant Plaza, Albany, NY 12203), 1976.

An example of the "Project Notification and Review System" established under Circular A-95 of the U.S. Office of Management and Budget (1969, with subsequent amendments), a form of early warning system intended to provide timely information on federal proposals and to assure coordination of plans, programs and projects in other federal agencies and with state and local levels. A-95 established state and areawide clearinghouses which identify jurisdictions and agencies (state and local governments as well as nongovernmental public organizations) whose interests might be affected by a proposed project, such as one proposed in an environmental impact statement. The idea is to give people an opportunity to participate in project reviews.

Canadian Nature Federation. *Canadian Conservation Directory, 1978-1979.* CNF (75 Albert St., Suite 203, Ottawa K1P 6G1), 1978. 96 pp. $2.00.

Comprehensive listing of over 400 local, provincial and national conservation groups including key government agencies.

Chisolm, Joseph. *Public Participation in Environmental Policy: An Annotated Bibliography.* Council of Planning Librarians (P.O. Box 229, Monticello, IL 61850), Nov. 1978. 17 pp. $1.50.

Christensen, Kathleen. *Social Impacts of Land Development: An Initial Approach for Estimating Impacts on Neighborhood Usages and Perceptions.* Urban Institute (2100 M St. NW, Washington, DC 20037), 1976. 144 pp. $3.95.

Part of a five-volume series (see Keyes, annotated in 5.5 Environmental Impact Assessment). This report suggests an approach and data collection procedures to enable planners to estimate the social impacts of proposed land developments. It focuses on ways to estimate how proposed changes to the physical environment may affect citizen's uses and perceptions of their neighbourhood. The report focuses on seven areas of social impact: recreation patterns at public facilities, recreational use of informal outdoor spaces, shopping opportunities, pedestrian dependency and mobility, perceived quality of the natural environment, personal safety and privacy, and aesthetics and cultural values. The appendix provides a sample citizen survey and discusses its application.

Collins, Diana, "A View from the Other Side: Citizens Participate in Planning Urban Housing", *Urban Forum*, Vol. 3, No. 5, Jan-Feb. 1978, pp. 14-23.

Presents a consultative approach to planning, oriented to housing but with wider applicability. The article includes a description of techniques for information-feedback, consultation and joint planning.

Community Planning Association of Canada, Nova Scotia Division. *Stop It! A Guide for Citizen Action to Protect the Environment of Nova Scotia.* Ottawa: Community Planning Press, 1976. 178 pp.

Connor, Desmond M. *Citizens Participate: An Action Guide for Public Issues.* Development Press (Box 1016, Oakville, Ont.), 1974.

Cupps, D.S., "Emerging Problems of Citizen Participation", *Public Administration Quarterly*, Sept./Oct. 1977, pp. 478-487.

Downs, Anthony, "Up and Down with Ecology – The Issue – Attention Cycle", *The Public Interest* 28, 1972.

The author argues that public issues lead to social reform through a series of five identifiable stages: 1. in the pre-problem period experts are alarmed over a highly undesirable social condition of which the public is not yet aware; 2. the public is suddenly confronted by the problem but enthusiasm prevails as people remain convinced that the problem will be solved and political leaders come under strong public pressure to bring forward policies leading to problem resolution; 3. many people begin to see that the cost of solving the problem is high and that large groups will have to make major sacrifices in their way of life, a realization that causes public interest to decline; 4. some people feel discouragement, others are threatened by needed change and many more grow weary of hearing about the issue (by then a fresh crisis is entering Stage 1 to capture their attention, as energy displaced environment); and 5. the issue moves off into limbo for the public. While new institutions are created to solve the problem labour behind the scenes, public attention shifts to another issue and another cycle.

Dubois, Philip L. and Christenson, Arlen C. *Public Advocacy and Environmental Decisionmaking: The Wisconsin Public Intervenor.* University of California, Institute of Governmental Affairs (Davis, CA 95616), n.d., about 1977.

The first major study of the Wisconsin Public Intervenor, an early (1967) experiment in public representation and advocacy in the adminstrative process. The paper evaluates the Intervenor's influence on the decision-making behaviour of the Department of Natural Resources and recommends several reforms. The authors argue that the concept of an environmental advocate is a promising one for ensuring representation of under-represented interests in agency decisions.

Ebbin, Steven and Dasper, Raphael. *Citizen Groups and The Nuclear Power Controversy: Uses of Scientific and Technological Information.* Cambridge, MA: MIT Press, 1974. Paperback, 292 pp. $6.95.

Traces citizen involvement in nuclear issues, citing specific cases. Recommendations are made to provide greater public understanding of scientific and technological issues, ensure proper consideration of matters of public concern and allow more adequate participation in decision processes.

Elder, P.S. (ed.). *Environmental Management and Public Participation.* Canadian Environmental Law Research Foundation (One Spadina Crescent, Suite 303, Toronto M5S 2J5), 1975. Paperback, 384 pp. $5.00.

Presently the only Canadian source that explicitly relates these two subjects, though heavily oriented to the legal perspective. Papers especially relevant to public participation are Bob Gibson, "The Value of Public Participation" and P.S. Elder, "An Overview of the Participatory Environment in Canada". Other papers discuss participation with respect to Canadian water management and then environmental management in British Columbia, Alberta, Manitoba, Ontario, Quebec and the Maritime provinces. Three additional papers deal with environmental impact assessment.

Emond, Paul, "Participation and the Environment: A Strategy for Democratizing Canada's Environmental Protection Laws", *Osgoode Hall Law Journal*, Vol. 13, No. 3, 1975, pp. 783-837.

Part I provides a conceptual examination of public participation and how it may be integrated into environmental decision-making, together with a discussion of principles of adminstrative law and how they may be used innovatively to begin democratizing Canada's environmental protection laws. Part II evaluates the extent to which these laws and the country's common law tradition of natural justice incorporate participation into the decison-making process. Part III touches on the implications of restructuring this process "to better utilize the important contribution which a concerned public can make to environmental protection".

Erickson, David L. *Public Involvement in Natural Resource Planning and Decision Making: A Selected Bibliography.* Council of Planning Librarians (P.O. Box 229, Monticello, IL 61850), CPL #1097, Aug. 1976. 18 pp. $1.50.

Etzioni, Amitai. *The Active Society: A Theory of Societal and Political Processes.* New York: Free Press, 1968. Paperback, 189 pp. $7.25.

Annotated in 1.3 Characteristics of Environmental Planning.

Fessler, Donald R. *Facilitating Community Change: A Basic Guide.* University Associates (7596 Eads Ave., La Jolla, CA 92037), 1976. Paperback, 146 pp. $7.70.

The first five chapters describe the general climate and community conditions within which the professional change agent must work. Succeeding chapters deal with the day-to-day problems to be faced and suggest principles and practices for dealing with them.

Friedmann, John. *Retracking America: A Theory of Transactive Planning.* Doubleday, 1973. Paperback, $3.95.

Friedmann distinguishes *personal* knowledge from *processed* knowledge. Citizens have an abundance of the former (through experiences) while planners are well equipped with the latter, knowledge built up from symbols that stand for particular dimensions of reality (statistics, surveys, reports, etc.). The two kinds of knowledge are complementary and both are needed for adequate planning and decision-making, he argues. A "transactive" style of planning would forge a relation between expert and client actor, joining processed knowledge to action through a series of personal transactions that would bring the rules of the two worlds into conjunction.

Gardner, Godfrey. *Social Surveys for Social Planners.* Toronto: Holt, Rinehart and Winston, 1976. Paperback, 165 pp.

A useful reference, clearly presented, discussing the choice of social surveys, planning them, observation, questioning, interviews, sampling , analyzing and interpreting data, writing survey reports, and maintaining a skeptical eye on social surveys. See also Donald P. Warwick and Charles A. Lininger, *The Sample Survey: Theory and Practice* (New York: McGraw-Hill, 1975), paperback, 144 pp. $8.25.

Goodman, Robert. *After the Planners.* New York: Touchstone Books, 1971. Paperback, $2.95.

A former architect-planner recounts, sometimes bitterly, his experience with advocacy planning, first put forward as a working model in an influential article by Paul Davidoff, "Advocacy and Pluralism in Planning", Journal of the *American Insititute of Planners*, Nov. 1965. A vigorous indictment of planners, and architects, implementing agencies and the urban-industrial/ military-industrial complex.

Grima, A.P., "The Role of Public Participation in the Environmental Impact Assessment Process", in Plewes, M. and Whitney, J.B.R. (eds.). *Environmental Impact Assessment in Canada: Processes and Approaches.* University of Toronto, Institute for Environmental Studies (Toronto M4S 1A4), 1977. 199 pp. $5.00.

Public participation is defined as all activities of private citizens, citizen groups and others trying to influence public decisions through boards, committees and other *ad hoc* bodies who make recommendations to the cabinet, a minister or a department (contrasting participation with two other modes of intervention - constituency organization and election of representatives, and litigation). The author describes a framework for developing a public participation program, discusses the why/who/how of participation, examines the public's role in EIA, and evaluates the public participation program of the International Joint Commission which conducted hearings on the Great Lakes in 1973. He concludes that public participation is equally important as the research effort that goes into writing an environmental assessment statement – the two are mutually reinforcing with research deriving added relevance from inputs by affected publics – but warns that a competent impact statement would weaken the position of those most eager to participate and strengthen the position of those charged by law with responsibility for making decisions.

Haefele, Edwin T. *Representative Government and Environmental Management.* Baltimore: Johns Hopkins Press, 1973. $12.00.

Hendee, John C. and George H. Stankey, "Applied Social Research Can Improve Public Participation", *Rural Sociology*, Vol. 40, No. 1, Spring 1975.

The authors argue that the main problem of public participation is particular agencies' unfamiliarity with how to incorporate public involvement effectively in their work. They propose a five-part model of participation: 1. issue identification; 2. information collection; 3. analysis; 4. evaluation; 5. implementation.

Hulchanski, John D. *Citizen Participation in Urban and Regional Planning: A Comprehensive Bibliography.* University of Toronto, Dept. of Urban and Regional Planning (230 College St., Toronto M5S 1A1), 1977. 61 pp. $6.00.

Keating, Donald R. *The Power to Make it Happen. Mass-based Community Organizing: What it is and How it Works.* Toronto: Green Tree Publishing Co., 1975. Paperback, 247 pp. $4.95.

A biography of four years of "the first mass-based community organizing project in Canada" which the author directed in the Riverdale area of southeast Toronto. The underlying assumption of this approach is that the basic problem in working-class communities is powerlessness; all other problems are merely symptoms. Winning and building power to decide are the two main goals. Working-class organizing is distinguished from middle-class organizing in which any social alienation is regarded as temporary and superficial. The middleclass group relies on lawyers and manipulation of the levers of power to which it usually has access.

Lash, Harry. *Planning in a Human Way.* Ministry of State for Urban Affairs (Ottawa K1A 0P6), 1976. Paperback. 96 pp. Free.

Lash, former planning director for the Greater Vancouver Regional District (2294 W. 10th Ave., Vancouver V6K 2H9), describes its innovative approach to planning "The Livable Region". The model, shown below, is based on a six-sided triangle of two-way relationships among planner, politician and the public.

Lassey, William R. *Planning in Rural Environments.* New York: McGraw-Hill, 1977. Hardcover, 157 pp. $17.95.

Annotated in 1.3 Characteristics of Environmental Planning. Chapter VIII, "Increasing the Payoff From Planning: Implementation and Involvement Process", provides a useful discussion of public involvement in planning.

Lucas, A.R., "Legal Foundations for Public Participation in Environmental Decision-making", *Natural Resources Journal*, Vol. 16, 1976, pp. 73-102.

Maurer, Kathleen F. *Public Participation Program Proposals.* Ontario Environmental Assessment Board (1 St. Clair Ave. W., Toronto M4V 1K7), 1978.

Based on the author's M.Sc. thesis at the University of Toronto, this report suggests options for conduct of the Board's hearings. Recommendations deal with the Board's interaction with the public, the needs of individual members of the Board, and the Board as an independent institution.

McDowell, Bruce D. (ed.). *Innovation and Action in Regional Planning.* University of Illinois, Bureau of Urban and Regional Planning Research (909 West Nevada, Urbana IL 61801), 1977. Paperback, 242 pp. $5.50.

Part 4 includes four papers discussing the involvement of citizens and community leaders in regional planning. See especially David E. Dowall and Joseph B. Juhasz, "A New Methodology for Citizen Participation in Land Use Planning", which proposes using public attitude assessment and the definition of "communities of interest" to create a process whereby planners and citizens may influence each other's actions.

Needleman, Martin L. and Carolyn E. *Guerrillas in the Bureaucracy: The Community Planning Experiment in the United States.* New York: Wiley, 1974. Hardcover, 368 pp. $16.95.

"Community planning" is defined as the opening of city planning to citizen participation on a decentralized basis. Planners are assigned responsibility for specific parts of the city rather than for the city as a whole (other planners look after that) and are expected to involve citizens in the planning process. This often brings the planners into clashes with their parent bureaucracies and produces internal value conflicts. Sometimes planners respond by becoming "adminstrative guerrillas", going underground within the city government as clandestine community advocates while preserving their cover as disinterested technical experts. This book, based on personal interviews with such planners, is organized around the key points of tension: the planners' relationships with citizens, their own agencies and other agencies; and the surreptitious role they assume. It describes the community planning pressure system and guerrilla tactics planners adopt to gain community trust, win benefits for

their areas and survive occupationally in a hostile organizational environment.

Nix, Harold L. *The Community and its Involvement in the Study Planning Action Process.* Washington, DC: U.S. Dept. of Health, Education and Welfare, Public Health Service, 1977. Paperback, 205 pp. Available from U.S. Government Printing Office (Supt. of Documents, Washington, DC 20402), Stock No. 017-0230-00120-5, $4.00 + 25% outside U.S.A.

Although aimed at health administrators and educators, this book has relevance to all community participation programs. Part One presents concepts of community and community leadership as well as a theoretical discussion of community change. Part Two offers an approach to the study-planning-action process including the identification of community leaders, organizations and factions and their involvement, along with citizens, in community change. The study-planning-action process has eight steps: 1. recognizing and describing the need or problem in the community; 2. determining relevant interests who should be consulted; 3. initiating and legitimizing the need; 4. diffusing the need to the public; 5. organizing to study and plan to carry out the project; 6. studying and planning; 7. implementing; and 8. evaluating the process and its effectiveness.

Pateman, Carole. *Participation and Democratic Theory.* New York: Cambridge University Press, 1970. Paperback, $3.95.

Examines theories of democracy and the role of citizen participation in a democratic political system. Evidence is provided to support the idea that participation is psychologically and educationally valuable. A system of industrial democracy is elaborated.

Reilly, William K. (ed.). *The Use of Land: A Citizen's Policy Guide to Urban Growth.* New York: Thomas Y. Crowell Co., 1973. Paperback, 318 pp. $3.95.

Chapter VIII is "Conservation and Development: The Role of the Citizen". Annotated further in 2.1 Land Use and Misuse.

Sargent, Frederic O. *Rural Environmental Planning.* American Society of Planning Officials (1313 East Sixtieth St., Chicago, IL 60637), 1976. Paperback, 199 pp. $7.00.

Sargent's approach to planning for rural areas is citizen-oriented. He proposes beginning with an attitude survey to discover public environmental goals, ascertain information deficits and set the stage for eliminating them, introduce new environmental concepts to people, determine how willing they might be to support environmental programs financially, and counter inaccurate perceptions politicians may have with respect to "what the public will support". Such an attitude survey must: 1. provide accurate information concerning present public concepts and public goals/priorities attached to them; 2. be conducted, analyzed and reported inexpensively and quickly; and 3. have an educational objective (stimulate a learning process about the environment – Sargent sees the attitude survey as a tool to be used at various points throughout the planning process). The book, annotated further in 1.3 Characteristics of Environmental Planning, includes a "Model Town Attitude Survey" on pages 32-33.

Sathré, Freda S. et al. *Let's Talk: An Introduction to Interpersonal Communication.* Second Edition. Glenview, IL: Scott, Foresman and Co., 1977. Paperback, 200 pp. $7.00.

A lively, readable introduction to communication processes. See especially Chapter 6, "Conflict Resolution".

Sax, Joseph L. *Defending the Environment: A Strategy for Citizen Action.* New York: Random House, 1970.

Sewell, W.R.D. and Burton, I. (eds.). *Perception and Attitudes in Resource Management.* Ottawa: Dept. of Energy, Mines and Resources, 1971. Paperback. 147 pp. Available from Supply and Services Canada (Printing and Publishing, Ottawa K1A 0S9), $3.00. Section 111, "Public Involvement and the Planning Process", includes five papers on public perception and resources planning, a strategy of public involvement, a case study of the Delaware River, perception of goals in water quality management of the Great Lakes, and integrating public views in planning and policy making.

Sewell, W.R.D. and O'Riordan, T., "The Culture of Participation in Environmental Decision Making", *Natural Resources Journal,* Vol. 16, 1976, pp. 1-22.

Smith R.W., "A Theoretical Basis for Participatory Planning", *Policy Sciences* 4, Sept. 1973, pp. 275-296.

An extensive incisive theoretical treatment of participatory models in various organizational contexts.

Solnit, Albert. *The Job of the Planning Commissioner: A Guide to Citizen Participation in Planning.* University of California, University Extension (2223 Fulton St., Berkeley, CA 94720), 1974. Paperback, 107 pp. $4.00 (cheque payable to the Regents of the University of California).

This book is aimed at helping the citizen, volunteering to help solve local problems, become more effective. It discusses amateurs in government, the language of planning and zoning, the planning process, group work, coordination, dealing with planners, understanding and handling the work on the agenda, and ethics. Chapter 7 (pages 75-91) explicitly addresses environmental quality, open space and growth.

Steggert, Frank X. *Community Action Groups and City Governments.* Cambridge, MA: Ballinger Publishing Co., 1975. Hardcover, $16.50.

Stein, Martin, "Application of Attitude Surveys in Transportation Planning and Impact Studies: A Case Study of Southwest Washington D.C.", *Traffic Quarterly,* Vol. 29, Jan. 1975.

Vindasius, Dana. *Public Participation Techniques and Methodologies: A Résumé.* Environment Canada, Inland Waters Directorate (Ottawa K1A 0H3), 1974. 31 pp.

Provides a selected review (12 projects) of experience with public participation in Canada and the United States, briefly analyzes the case studies, sets out 11 public participation techniques and formulates a model public participation program.

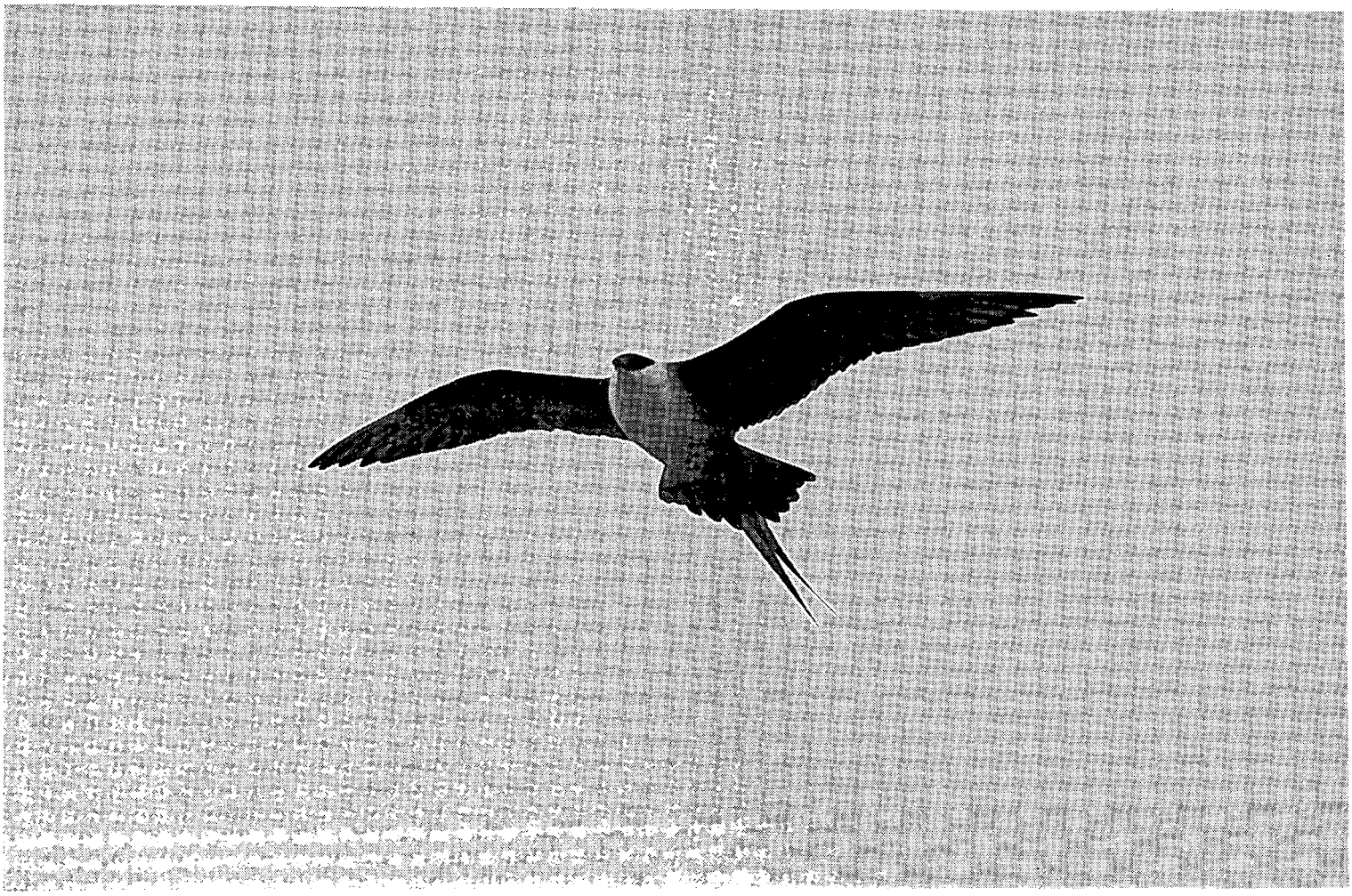
Webb, Kenneth and Hatry, *Obtaining Citizen Feedback: The Application of Citizen Surveys to Local Government.* The Urban Institute (2100 M St. NW, Washington, DC 20037), 1973. Paperback, 105 pp. $1.95.

Wilkinson, Paul. "The Role of the Public in Environmental Decision-Making", in Dwivedi, O.P. (ed.). *Protecting the Environment: Issues and Choices – Canadian Perspectives.* Vancouver: Copp Clark, 1974. Paperback, 339 pp. $6.95.

Yukubousky, Richard. *The Task Force: One Approach to Community Participation.* New York State Dept. of Transportation (Albany, NY 12225), 1973. 90 pp.

Provides guidelines for effective use of the task force as a mechanism for participation, especially in transportation planning. See also: Yukubousky, *Community Interaction in Transportation Systems and Project Development: A Framework for Application* (NYSDT, 1973), 276 pp., which appends a lengthy "Catalogue of Community Interaction Techniques".

Appendix



Appendix A
The Research Project

The "Resources for Environmental Planning" research project, responding to the problem of how to increase the degree of environmental consideration in planning/decision-making/management at the urban and regional level in Canada, was conceived early in 1977 by Reg Lang and Audrey Armour. An unsolicited research proposal was submitted to the Ministry of State for Urban Affairs and to Environment Canada, Lands Directorate. Favourable response from the latter agency led to negotiations resulting in a contract, through Supply and Services Canada, finalized in late Fall 1977.

The contract, effective 1 October 1977, called for preparation of an "Environmental Planning Resourcebook" in three phases: I. identification of specific issues and problems, perceived by practitioners in the environmental planning/management field; II. preparation and circulation of a draft of the Resourcebook to a selected group of Canadian practitioners for their comments and contributions; and III. conduct of a workshop to assemble 50-75 of these people, revision of the Resourcebook as required, preparation of a camera-ready copy for publication, and documentation of the research method. The contract as finally amended provided $18 244 in total funding (including $4 544 for costs of running the workshop) over the eleven-month period October 1977 to August 1978. The project was administered by York University through the Faculty of Environmental Studies and the Office of Research Administration.

The project team comprised:

Principal Investigator:	Reg Lang, MCIP, P.Eng., Professor in Environmental Studies, York University
Research Associate:	Audrey Armour, B.A., M.E.S., environmental planning consultant and lecturer (part-time) in the Faculty of Environmental Studies, York University.
Senior Research Assistant:	William Hughes, B.A., graduate student in the M.E.S. program, Faculty of Environmental Studies, York University.

Phase I. From October 1977 to March 1978 the research team undertook an extensive search of the literature and assembled a substantial base of information on environmental planning/management primarily in North America. The emphasis was more on (a) natural environments, as affected by human activities, than on social impacts, (b) urban, urbanizing and urban-affected environments than on wilderness areas, and (c) the local or municipal scale rather than the provincial or federal. Various formats for the Resourcebook were considered and, as a cooperative effort by the three team members, a 153-page draft Resourcebook was prepared and printed.

At the same time participants in the research project were lined up. A short list of key practitioners in the field was assembled through personal knowledge and contacts. In January 1978 each of these people was sent a letter (accompanied by two foldouts, one describing the project and the other a brief bibliography to signal the range of subject matter considered appropriate) inviting him/her to take part in the project and asking for nominations of two or three others. The letter emphasized that the team was not particularly seeking people in senior positions – they were easy enough to identify – but instead hoped to locate those dealing with environmental problems directly and making significant contributions to the environmental planning field. A second letter was sent in early February to prominent individuals and organizations involved in or associated with environmental planning and management in Canada, asking for more names of potential participants for the project. Altogether, 67 such inquiries were sent out. As a result, 117 people, from across Canada and displaying a mix of backgrounds and agency affiliations, were invited to join the project; participation implied a commitment to review the draft Resourcebook, help find appropriate examples of environmental planning practice, and attend the workshop. Of these, 75 accepted and 55 eventually participated; 49 of them reviewed the draft (several others read parts of it, informally) and 51 (not necessarily the same) attended the workshop. A list of the project participants, including their agencies and addresses, appears at the end of this Appendix.

Phase II. In April 1978 the first draft Resourcebooks were sent out. Included with each copy was a set of worksheets, one per section of the Resourcebook, which requested that readers (a)

note errors or omissions in the text, suggest needed additions, indicate agreement or disagreement with positions taken, list additional information sources and indicate relevant research studies not mentioned in the text, and (b) on the reverse side of the worksheet, document at least two examples or case studies that demonstrated points made in the text or otherwise illustrated current, especially leading-edge, practice. Participants were to return the worksheets by the third week of May so that the results could be analyzed prior to the workshop.

Phase III. The workshop was held at York University's Glendon College in Toronto from noon Wednesday 7 June to early afternoon Friday 9 June 1978. In attendance were 51 of the project participants (excluding the research team and assistants), noted on the list at the end of this Appendix. Geographic, disciplinary and agency affiliation were reasonably diverse and representative of the field. Despite the team's considerable efforts, however, no one attended from Newfoundland or the North (although some of those present had experience in these areas) while New Brunswick, Manitoba, Saskatchewan and Alberta had only one representative each. The non-governmental sector was similarly under-represented.

Stated objectives of the workshop were: 1. to identify and define more clearly the environmental planning/management problems that Canadian practitioners were addressing and the approaches they were using; 2. to provide a first-hand understanding of circumstances facing practitioners, including barriers to and opportunities for environmental planning; and 3. overall, to assist all participants, including the research team, to establish new contacts, share and compare ideas and experience, learn more about planning problems and solutions, (a list of the submitted case studies was circulated, for example) and contribute to development of the field. These aims, however, were adjusted to take account of the expectations of the participants. They were asked in advance to suggest the kinds of things they would like to see happen at the workshop, list the environmental problems they most frequently encountered in practice, and provide biographical information for the team's use in designing the workshop process.

The project budget for the workshop included limited financial assistance to cover: travel costs of those far away and particularly in need ($2 391 was used to assist seven participants traveling from British Columbia, Alberta, Manitoba, Nova Scotia and Prince Edward Island); accommodation at Glendon College, for those requiring it, and most meals; the costs of meeting rooms; and incidental expenses associated with running the workshop. Five graduate students in the M.E.S. program at York University (Joe Barbieri, Jim Burke, Tom Melymuk, Alan Rotman and Shelley Wells-Rycroft) volunteered their services as recorders, process observers and general workshop assistants. The research team and assistants met at the end of each morning, afternoon and evening session to discuss what had happened, identify problems and, where necessary, adjust the process.

The workshop agenda was deliberately process-oriented. Rather than arranging speakers and formal presentations, the team opted for an approach that identified participants' interests, organized people into leaderless small groups to discuss assigned questions and undertake other specific tasks, provided plenary sessions to pool what was being learned, and arranged free time where participants could get together informally (a "publications table", displaying books and reports provided by team members and participants, assisted in this respect). Three kinds of discussion settings were used: interest groups, which brought together people with similar interests and asked them to identify the main environmental problems and planning approaches; issue groups, which focused on identifying and defining the key environmental issues; and task forces, which pinpointed the most promising environmental planning/ management initiatives. A summary of the workshop discussion is available, at cost of duplication, from Reg Lang, Faculty of Environmental Studies, York University.

An evaluation, conducted at the end of the workshop, indicated that:

> The workshop was moderately successful as a learning experience for the participants (they rated it on the basis of their own expectations, not according to the foregoing objectives). On a scale of 1 (learned little) to 10 (learned a great deal) they gave it an average score of 6.1.
>
> The majority of participants felt they had a reasonable, or even considerable, opportunity to exchange ideas and share information and experience.

Other positive aspects of the workshop most often mentioned were its organization and group dynamics, the diversity of people and viewpoints present, and the informal free-speech setting. On the negative side respondents criticized the absence of specific case-study presentations, the superficial and abstract (one said "pedantic") nature of some of the discussions, lack of representation of certain areas and interests, too many generalist planners and too few knowledgeable specialists, and an overly structured process.

Participants had spent an average of 11 hours reviewing the draft Resourcebook (the range was 1½ hour to 30 hours).

93% of the participants felt it would be useful to have some kind of follow-up to the workshop and Resourcebook, with 68% favouring another workshop in one or two years time and 54% supporting creation of an information network specifically on environmental planning. The most commonly expressed desire was for a regular review and update of the Resourcebook with emphasis on case studies.

As a result of the workshop and participants' review of the draft Resourcebook, the research team (primarily the Principal Investigator) reorganized the book's structure and substantially expanded its content. Case studies were edited and returned to contributors for correction as required. The format and graphics of the final Resourcebook were determined. the remainder of the project involved a great deal of writing/rewriting followed by preparation of the manuscript for publication.

The research method used here is simple and fairly easy to replicate, either for the entire field of environmental planning/management or for parts of it (for example, environmentally sensitive areas, or environmental impact assessment). It involves a *core team* possessing knowledge of the subject matter as well as synthesis and documentation skills. The team identifies *key practitioners* who "ground" the research, help pin down central problems and issues, and contribute *case studies*. In a field dominated by practice rather than theory, bringing the group together through a *workshop* clarifies the subject matter and allows it to be explored interpersonally. Finally, the *resourcebook* itself, proceeding from a draft to the final version, fills an information gap in the field. Aside from its immediate utility to planners and students, such a source: helps sort out (structure) and unify the field by linking its practitioners; offers a focus for further development of theory and practice in specific settings; and provides a teaching/learning tool for practitioners and researchers in related fields as well as politicians and publics to whom the field may seem exceedingly obscure. Such a resourcebook is not difficult to update, and it may be the springboard for further steps, such as an information network, in the process of developing the field.

The Workshop Agenda

Wednesday:	
12:30 – 1:30	Registration
1:30 – 2:30	Plenary session: introduction; explanation of upcoming sessions and selection of groups.
2:30 – 3:45	First set of Interest Groups (subject-oriented):
	Urban infrastructure Urban/urbanizing natural areas Non-urban natural areas Floodplains and other hazard lands Rural environments Streams and valleylands Lakes and shorelines Agriculture
3:45 – 4:00	Break
4:00 – 5:30	Second set of Interest Groups (methods-oriented)
	Environmental impact studies Resource inventories Environmental policies Environmentally oriented regulations The carrying capacity concept Informing and involving the public Communicating environmental information
5:30 – 6:30	Dinner
7:00 – 7:30	Plenary session to explain the next session and select groups

7:30 – 8:45	Issue Groups, two (A and B) per topic Environment vs. economy, and the "energy crisis" Protection vs. use of significant environmental resources An environmental ethic: prerequisite to environmental planning? Private property rights vs. the public good Overlapping and conflicting jurisdictions
8:45 – 9:30	A and B Issue Groups share findings
Thursday:	
9:00 – 9:30	Plenary session to explain next session, select groups
9:30 – 12:15	Task Forces on environmental planning initiatives Devising an environmentally sensitive area program Preparing and implementing an regional environment plan/ strategy Preparing and implementing a local environmental plan/ strategy Relating environmental impact assessment to environmental planning and management Devising environmentally oriented regulations/controls Creating effective administrative arrangements Developing popular support and political commitment
12:15 – 1:30	Lunch, films
1:45 – 5:30	Plenary session: feedback from Task Forces
Evening	Films, free time
Friday:	
9:00 – 11:00	Plenary session: complete feedback from Task Forces 11:00 – 11:15 Break 11:15 – 12:30 Plenary session: support systems for environmental planners 12:30 – 1:00 Closing and workshop evaluation.

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Appendix B
Selected Addresses for Environmental Planners

Government agencies are listed under the name of the province (e.g. Nova Scotia) or state (e.g. California). Federal departments and agencies appear under Canada, United States, and so on. Municipalities are listed under the name of the municipal unit (e.g. Calgary, City of); some but not all of those referenced in the text are included herein. Consulting firms listed are those whose members who participated in the research project or whose reports are referenced in the Resourcebook (a list of environmental consulting firms is provided in: Canadian Nature Federation, *Canadian Conservation Directory 1978-79).* Universities are listed as they normally referred to (e.g. University of British Columbia; York University, etc.). Other selected environmental organizations of interest to planners are listed. Publishers, whose addresses are readily available in any library or bookstore, are not included.

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