Canadian Environmental Advisory Council
Conseil consultatif canadien de l'environnement

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Canadian Environmental Advisory Council

Selected Papers from Assemblies of the Environment Councils of Canada 1975-1980

Northern Roads Construction

Land Use Issues

Environmental Assessment Policies

Hydro Development Effects

Coastal Zone Management

Canada

Canadian

Environmental

Advisory

Council

Report No. 14

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Ottawa, Canada
K1A 0H3

Cat. No. En 93-14/1985E
ISBN 0-662-13973-9

Ce rapport est disponible en français

ACKNOWLEDGEMENTS

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with the assistance of Hélène Bruyère

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PREFACE

Shortly after the establishment of the Canadian Environmental Advisory Council in 1973, it became obvious to the members that many of the problems coming to their attention were shared by a variety of like bodies set up to advise the provincial governments. Accordingly, the Council took the initiative of convening a conference with the provincial councils which was held in Ottawa in 1975.

This was the beginning of a series of annual assemblies at which the federal and provincial councils reviewed their activities, assessed their successes and failures, shared opinions, discussed mutual concerns, and became better acquainted with the diversities and similarities of environmental problems in Canada.

Subsequent meetings were organized by the respective provincial councils. Early in the series, they adopted the practice of taking this opportunity to formulate resolutions on matters of national environmental consequence. It was expected that these resolutions, having been endorsed by a nation-wide group of concerned environmental advisers, would be considered worthy of serious attention.

The organizers of each assembly devoted parts of the agenda to addressing certain themes, such as hazardous wastes, acid rain, land use, ecological reserves, etc. Position papers and keynote addresses were commissioned by the organizers, and the texts circulated, but the reports of the assemblies were not disseminated much beyond the compass of the participating councils themselves.

The councils decided that a collection of papers from these assemblies would be worth publishing to make them available to a wider public. This report comprises selected papers from the first five assemblies. These papers -- on northern road construction, national land use issues, environmental impact assessment, the effects of hydro development on rivers, and coastal zone management -- were chosen in the hope that the perspective provided would be of continuing interest.

Tom Beck
Chairman

SOME ENVIRONMENTAL CONSIDERATIONS IN THE PLANNING, CONSTRUCTION AND MAINTENANCE OF NORTHERN ROADS WITH RELEVANCE TO THE MACKENZIE VALLEY HIGHWAY[1]

Ian McTaggart-Cowan*

The introduction of a highway through hitherto wild land initiates a series of events of the greatest ecological consequence. Through most wild landscapes the highway becomes the most obtrusive human alteration. At the same time, it is safe to say that despite an increasing variety of modes of travel and transportation, the well constructed, all weather highway for automobile use is regarded as the one essential element in establishing permanent residence. It breaks the tyranny of the time table, imparts a sense of belonging to a larger community, and has the further advantage over other transportation means of unlimited ingress and egress.

Traditionally, the highway from conception, through location, design and construction has been the prerogative of the engineer but this is no longer adequate. Through the last few years there has been rapid increase in the concept that the auto highway, as a major instrument of social purpose, has aspects to it beyond the area of expertise of even the most enlightened civil engineer. There are considerations in location, design, construction and maintenance that require the viewpoint, philosophy, and skills of a team of experts to work along with the engineer as he translates goals and constraints into construction terms. The ecologist, the geologist and the landscape architect become essential participants in the design process and frequently also in establishing principles of maintenace. From time to time this team will need much broader advice even than this. The Northern Roads Task Force (1971) established by the Government of Canada to examine the environmental impact of certain highways in the Yellowknife area is a good example of the contemporary approach to road planning.

"It is something of a paradox that far more sophisticated approaches are made to the problems of frost on highways in regions less cold (but more populous) than the Canadian north. On site investigations, soil sampling and testing, preconstruction procedures and design considerations are usually more intense."

"It is characteristic of the opening of new regions for development that engineering involves more brawn than brain." (Wallace and Williams 1974).

Our concerns are with the major environmental issues arising from the construction of a main highway, specifically that down the Mackenzie Valley. The impact of such a project includes some matters that are essentially biological (i.e., ecological) while others are clearly of an esthetic nature. The two aspects of environment, as seen by knowledgeable and perceptive individuals, merge imperceptibly; the ecological alterations distinguished by their susceptibility to measurement, the esthetic immeasurable, but no less real and urgent.

The greatest environmental impact will almost certainly arise not from the highway construction itself, but from the train of events that inevitably follow. Industries will become viable that were not in the past. Truck transportation will be prominent among these. This will involve great increase in heavy truck units. In turn this use of the highway will necessitate base camps or service centres perhaps every 100 miles or so. Usage by tourists will bring about camp grounds and the provision of facilities for dispensing fuel, food and lodging. It is important that the planning for the highway consider the location of such ancillary facilities and design zoning or other constraints on development that will contribute to an effective, efficient and attractive total plan. Such stopping places can be located in circumstances best suited to their requirements and where they will not mar vistas and contribute to the pollution of lakes and streams.

Since no details have been available to the Canadian Environmental Advisory Council of the studies that have preceded the authorization of the Mackenzie Valley Highway construction, or of the specifications and constraints developed to guide the details of location, construction and operation of the highway, we can express our concerns only in general terms.

A road preempts land formerly occupied by native plants and animals, it intrudes a wedge into hitherto unbroken areas of uniform ecotype, it brings new forms of destruction to those creatures that are unable to adapt their lives so as to tolerate the intrusion, it may alter streams, rivers and lakes, generally to the detriment of fish in them. It alters the thermal and hydraulic balance of soils and through this may introduce secondary destructive forces that may be either blatant or elusive but are pervasive and spread their influence to areas

1. Presented at the 1975 Assembly of Environment Councils of Canada.

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far remote from their source. Foreign influences flow along them; there are continuous corridors of disturbed soils for the entry of introduced weeds; man – the hunter and fisherman – is brought into close contact with wildlife and fish populations formerly untouched, and thus new management situations are created. It greatly alters the human communities it contacts, frequently in ways that change the relationship between people and the living resources. From an engineering point of view a route may present good alignment while from the standpoint of other values some other route would have been preferable, preserving intact choice areas for fishing and camping and avoiding prime wilderness regions. The cost of one route may be no greater than the other but the choice arises from the initial concepts. Certainly with its passage the wilderness is no more.

The concept of wilderness is of an area of particularly choice landscape of esthetic and scientific interest, in which man-made artifacts are absent as a value. It is recognized by our society as a specific form of land use. Wilderness is a legal entity in several Provinces of Canada and is widely treasured by an active and enthusiastic body of users. It is a value which should enter into the routing of new highways in wild land areas.

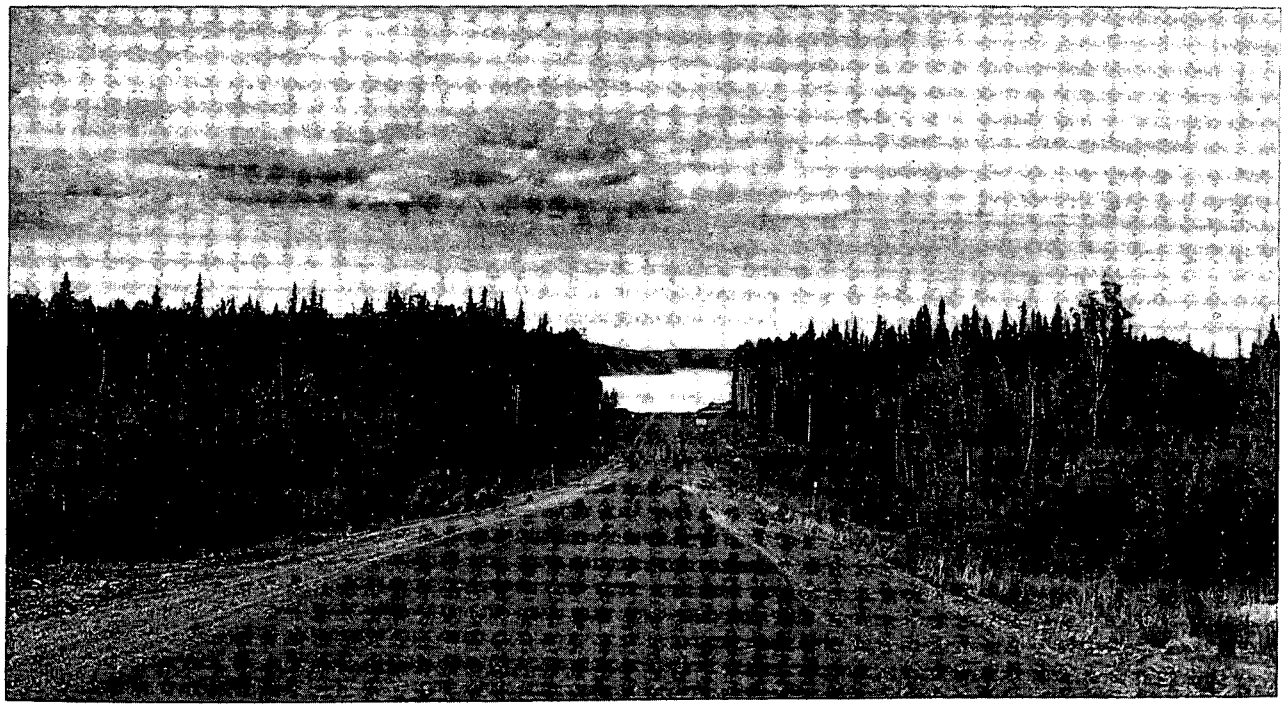
It is well known that different types of landscape – different ecotypes – differ greatly in their tolerance of the man-induced changes that accompany the highway. Among the most sensitive are large areas of the north where frozen soils along with peculiarities of drainage and of living organisms give rise to exceptional challenge to the perception, understanding and skill of those who plan, build and maintain road systems.

The Planning Phase

Designation of Purpose: It need hardly be emphasized that any new highway concept requires the most careful designation of purpose as a first stage of planning.

Is it conceived as a major artery, designed to join, permanently, settlements that can no longer be adequately served by alternative and less destructive transportation? Is it a road to an ephemeral resource centre, unlikely to give rise to permanent settlement? Is it to be for a long time a minimum link between scattered homesteads and their sources of supply and social contact? Are scenic values paramount, as they are in a National or Provincial Park? Is the highway the best answer to the designated social needs, or will a railway or perhaps a subsidized airline fill the void adequately and with fewer retrogressive alterations to the environment? As Clarke (1972) put it, there are three lines of questioning: 1. Do we really need it? 2. Are there alternative locations? If not, and the only possible location is destructive, then we are thrown back to the first question: 3. How, in all cases, can environmental damage be minimized?

The cost of constructing and maintaining a modern highway in the northern areas can be very great. Inevitably economic considerations enter into decision making at each stage. Often, however, least cost considerations may neglect ecological and environmental considerations which should be acknowledged as legitimate items in the budget. Frequently, also, neglect of geological and ecological considerations can lead to significant increase in total costs.



Mackenzie Highway near Fort Simpson

There is also the not inconsiderable factor of 'cultural shock' experienced by more remote communities when confronted with the arrival of a busy highway. Our fixation with automobile transportation blinds us to the fact that the highway may sometimes be a doubtful blessing.

New elements in our social purpose are the concern to fulfill the goal of bringing highway facilities to a new community while at the same time observing the larger objective of maintaining the well-being of the environment and retaining as many as possible of the foreseeable options.

Highways are for people, those that use them and those that live along them. The great increase in recreational travel dictates that all northern highways be considered as important elements in the Canadian landscape. To Canadians from further south, as to our visitors, the roads they travel introduce them to the great natural features of our landscape, the forests, lesser plants and the rich variety of wild creatures, as well, also, to the way Canadians regard their land. Stansbury (1968) puts it this way: "Highway development is currently the primary determinant of the quality of the environment in which we live. The highway determines what we see, when we see, and how we see land and the human development upon it." As detailed by Pushkarev (1965), highways can be beautiful, by design, by location and by landscaping, and this too should be considered an objective. Just because the road is passing through little travelled virgin lands is no reason to ignore the full potential. Mistakes are costly and remain obvious for decades.

At the same time highways in 'the North' introduce familiar hazards to the user in more exaggerated form. As Wallace and Williams (1974) have stated: "The hazards met by the northern traveller are those of snow and ice, floods, washouts, pot holes and mud and land slides. All of these occur in the more southerly part of Canada, in certain places and at certain times of the year. But in the north they are met with more frequently, for longer periods, and more often associated with darkness. Furthermore, the consequences can be more serious if help is 200 miles away."

Highway safety considerations therefore take on a different and more urgent perspective in planning for highway construction and maintenance in the north.

Babcock (1965) suggests several important steps in defining the objectives of a new highway in making maximum use of opportunities for an attractive development. These we have modified to make them more directly appropriate to the present task.

Step 1 Recognize and fully utilize the best of local scenery, be it mountains, desert, farmland, city or shore.

Step 2 An esthetic inventory to include all features within a broad strip which could contribute to a more beautiful highway. This should include also a negative inventory of those features which will detract from this objective.

Step 3 Prepare an engineering checklist covering alignment, grade, soil type, drainage features, permafrost, ground ice, source of construction materials and many other details.

Step 4 Prepare an ecological inventory to include major floral areas with particular attention to wetlands, other specially sensitive and valuable ecotypes, major wildlife features, streams to be crossed and their resident or migratory fish stocks.

Step 5 Prepare a landscape inventory including such important items as the adequacy of the right of way; the presence and location of historical or archaeological features that should be preserved; the availability of important vistas that should be featured; the most appropriate places for rest stops or picnic sites; river banks or lake shores that should be avoided. Other questions of importance for such an inventory are: a mile-by-mile catalogue of any special specifications for clearing; plantings that will be required for erosion control; gradients that should be established along cuts and embankments in order to facilitate revegetation; documentation or regulations in place or needed regarding the use of adjacent lands.

Inevitably there must be trade-offs, e.g. a road or route having beautiful views might well increase the cost of construction unreasonably and expose the road and its users to rock slides, avalanches or other dangers.

A concern to include all five of these steps is essential if a road is to be not only 'good' from the engineering viewpoint, economic as seen by government, while designed to serve its greatest potential in the total spectrum of values available from our lands and their resources; the perceptive and recreational values, in addition to the material considerations that so frequently dominate decision making. Naysmith (1971) in orienting conservation to the northern lands of Canada presents a useful summary of the four elements of conservation in the contemporary setting. He suggests a series of four elements – preservation, protection, managed use and restoration – that are as appropriate to the northern road builder as to others whose responsibilities include development of northern lands.

Of particular importance is adequate control over development along the highway and the design and placement of directional signs. A scenic reserve or other appropriate regulation, including scenic easement through private lands is now recognized as important to the protection of the attractiveness of highways.

Stansbury (1968) outlines the role of the landscape architect in the road design process. "Landscape architects carry out site analysis studies by way of inventories of natural and man-made features that will influence both the character of the road, and its specific location. The inventory often includes the following:

(a) Potential sites for adjacent land use, e.g. service and maintenance areas.

(b) Scenic values, including all visual features of the landscape (rural or urban) and their desirable or undesirable character. Scenic analysis studies readily show the significant visual differences between two opposing directions of travel.

(c) Situations requiring critical conservation measures, e.g. streambank stabilization, wildlife habitats and flows, potential slope erosion, wildlife habitats and crossings.

(d) Vegetation conditions such as unique stands of timber to preserve; and areas subject to the windthrow, sunscald and water table changes which often occur as a result of highway development.

(e) Topographical conditions – to ascertain gradients, bridge locations, potential grade separations between lanes, areas of rockfall, etc. (These are as appropriately the domain of the engineer).

In addition to revealing the best highway location, resource inventories delineate areas of desirable legal controls for resource protection beyond the immediate right-of-way. Highways must respond to these additional factors if the driver and surrounding land users, as well as the vehicle, are to be accommodated." There have been some landscape architect studies along the Mackenzie Highway. However, landscape architects are not ecologists and frequently have little biological training and experience. All such plans should be reviewed for their compatibility with ecological and engineering objectives. The checks and balances of the team approach are essential to effective planning of such a major project as the Mackenzie Highway.

Biological Factors

Vegetation: There are several levels of sophistication in classifying the vegetation of the Canadian Northlands. Rowe (1959) has presented a detailed analysis of forest lands of Canada, including the regions with which we are concerned. Naysmith's (1971) treatment appears adequate as a background for a highway oriented discussion. He names eight plant associations each of which is readily distinguishable and presents characteristics of importance to those who must plan, construct, and administer a northern highway system. There is an extensive literature on boreal plants including many references to disturbance and reinvasion of plant life into disturbed areas. Pruitt (1970) has reviewed recent literature on the inter-relationships between permafrost and tundra biotic communities. Wein (1971) reports on a survey of major plant communities along a proposed gas pipeline route through the northern Yukon, where he identified nine major plant community types. These differ in such physical and chemical properties of the soil as water content, drainage characteristics, depth of the active layer and the presence, absence and amount of ground ice. These are characteristics of concern to the road builder. They are also important ecological parameters to the student of animal ecology.

Another important outcome of studies by Wein and others is the documentation of the extent of previous fire damage in northern areas, and some of the vegetative consequence of these. Fire is a frequent companion of road building and of the presence of a road. It can cause serious engineering problems both in construction and mainenance of a highway. Fire is widely destructive of important animal habitats, particularly those used by animal species adapted to living in 'mature' or 'climax' plant associations. It also alters the snow regime and the water cycle, frequently to the detriment of aquatic wildlife and fish. Scotter (1971) has reviewed the relationship between fire and caribou.

On the other hand, in some terrain a road may act as a fire break and it may also permit quick access by fire suppression crews and an overall reduction in fire damage.

In the area studied by Wein (1971) rocky summits and riverside communities were the types least subject to fire. He found also that there were native species of each plant community that have the ability to invade and vegetate disturbed areas.

Fishes: The rivers and lakes of northern Canada mostly support an indigenous fish fauna that is rich in species specially adapted to the peculiarities of the region.

The thermal cycle of the waters in which they live features extended periods of near freezing temperatures, separated by shorter summer periods during which the water warms enough to permit active feeding and growth. In most species the ice free period is also the period of reproduction.

A second major feature of northern waters is the long period (up to 8 months) during which they are ice covered. For the greatest part of this the ice is overlain by a snow cover which has the effect of greatly reducing the sub-ice light levels. The extended northern winter is also the period of negligible activity of insects and other terrestrial invertebrates that, in warmer climates, provide an abundant source of food for

fishes. Thus cold, low light levels and a cessation of surface input of food organisms combine to induce a growth rate much slower than that experienced by fishes, often of the same or closely allied species, in more equable climates.

It is well demonstrated also that oxygen levels fall to low levels during the lengthy winter periods. This is particularly so in the deeper parts of some lakes. Low levels of oxygen supplement other forces leading to a low productivity of northern waters. None the less, the fish stocks of northern rivers and lakes have been a rich source of food for northern human populations and continue to be so.

A few larger lakes have been harvested commercially for many years and have demonstrated their capacity to produce a sustainable yield of such species as lake trout and some whitefish. More recently some stocks of Arctic char in the eastern Arctic have been successfully exploited as a basis of a small industry exporting a luxury item to the North American markets further south.

To an increasing extent also the recreational fishing potential of northern waters is being recognized. Lake trout, brook trout, Arctic char, Dolly Varden char, Arctic grayling and northern pike are the more important species that are frequently locally abundant, and offer exceptional sport fishing.

The rivers of the north can be grouped into two major categories as to whether or not their waters are silt laden. These differ in the fish species they support, the food potential, the recreational potential and also in the restraints that are imposed on adjacent development. A silt laden stream may be able to tolerate some increase in its silt burden without major biological damage whereas a clear stream rendered silty is physically altered to an extent that its native fish fauna will be destroyed. If the pollution persists for more than a year or two rehabilitation or natural recovery becomes impossible.

Some understanding is required of the way in which various fish species use a water in their total life cycle if a sensitive job is to be done of handling the interaction that may develop as road construction comes into contact with natural waterways. Many lake fish spawn only in the streams that enter or leave the lakes. At relatively precise times each year the native fish enter the streams and pass up them until they reach the spawning beds. These are largely determined by physical characteristics of the substrate such as the size of particles, the mix of sand and gravel, its permeability, the rate of water percolation through the gravel, freedom from silt, protection from freezing, depth and velocity of water. For most of the important sport fish clear water is essential either throughout life or at least for spawning. Silt laden water obscures visibility for those fish which feed by sight, obstructs the respiratory function of the gill, and destroys spawing beds and smothers eggs and fry in the beds.

Thus it is that other than by complete obstruction to the movement of fish up and down a stream, the introduction of silt to a relatively clear stream is the most important probable source of damage to a fish resource that can arise from road construction.

Damage arising from silt pollution is unlikely to be an all or none event. The extent of damage accruing will depend on the nature and amount of the silt, the physical characteristics of the stream and the adaptive capacity of the fishes involved. The detailed studies necessary to assess probable degree of damage under various predictable circumstances is likely to be costly and the course of best judgement is usually to take the steps necessary to avoid the problems. In general, well located bridges are likely to be cheaper in the long run as they avoid interference with stream channels. However, culverts frequently appear cheaper in the short run to those who do not appreciate the long run consequences.

Shotten (1971) has summarized data relating to the influence of siltation upon stocks of stream living fishes. His references refer particularly to salmon and trout and other species may be more or less sensitive. "Surface runoff from snowmelt, rainfall and cut-bank seepage occurs on nearly all forest roads. As the surface runoff becomes concentrated into rivulets by the microtopography of the surface it can cause erosion of the road surface and banks. Such erosion is reduced by proper drainage measures which will depend on the steepness of grade, nature of the road surfaces, etc. Guidelines have been established for such preventative practices in forestry, e.g. Lantz, 1971; many of these would be appropriate to the present project.

Controlled experiments have indicated that care taken to reduce destruction of river banks and to minimize runoff effects can prevent large increases in turbidity. In one study, roads were limited to grades of 10%, except where conditions dictated somewhat steeper grades for short distances. Turbidities of 25 p.p.m. were recorded compared with 56,000 p.p.m. for the comparison area where no restrictions had been placed on the siting and construction methods of roads, and no special care taken to minimize stream bank disturbance and consequential scour (Reinhart, Escher and Trimble 1963). The extent of protective practices is dictated by the nature of the terrain and climate, e.g. in Pennsylvania it is recommended that access roads are kept 25 feet from watercourses plus 2 feet for every 1% slope of the land between the road

and the watercourse." In northern areas this may well be far too close and 150° of leave strip along rivers and lakes appears better suited to the ecological and geological conditions. The question arises, are there studies in the Northwest Territories that confirm or alter these specifications for the various landscapes traversed by the Mackenzie Highway? In the absence of any new information will stipulations similar to those indicated above be enforced along this highway?

There is much experience to be gained from the Alaska Highway, the Canol road and the Dempster Highway. We urge that detailed studies of these be made and the results incorporated in the planning of the Mackenzie Highway and other roads that may be built in northern wild lands.

Chemical Pollutants

Fish are probably more sensitive to chemical pollution than are most warm blooded animals. A wide variety of man-made chemicals when entered into fresh water are toxic to fish. Some act by reducing the natural oxygen level in the water, others enter into the body chemistry of the organism in various ways that may kill fish, or alter their functions in such a way as to reduce the chances of survival. Research into the details of subacute influences of aquatic chemical pollution is meagre, but enough is already known to permit the statement that alterations in behaviour which expose fish to early death from normal causes of mortality are probably the most frequent and important consequences of chemical pollution of rivers, streams and lakes. Highways may be direct sources of pollution from a number of sources, lubricants and combustion effluent, chemicals used to melt snow or lay dust and sprays applied during plant management on the verges and lateral strips are probably the most prevalent sources of chemical pollution of roadside waters. Sewage, lubricants, insecticides and other miscellaneous effluents from construction camps during the road building period, spills of cargoes resulting from highway accidents, are other sources of potential problems. What criteria have been established regarding the transport, storage, use and disposal of potential pollutants during the construction and operation of the Mackenzie Highway?

Physical Obstruction

Obstruction to the movement of fishes up and down streams can deny them access to essential spawning grounds and opportunities to move out of areas habitable only at some times of the year.

A frequent cause of obstruction that arises from highway building is alteration in stream velocity. The choice between a bridge and a culvert should involve consideration of fish stocks. Culvert design also has an important involvement in successful fish passage. There are few data on our northern species but there is a body of data arising from irrigation canal studies in California.

Bridge structure also can be important on northern rivers that fluctuate greatly in flow with the snow melt. In general, spans should be long so that piers do not constrict normal passage, and gather ice and debris with resulting flooding and major changes in the stream bed. There are now arch-type bridges that may combine both esthetic appeal and ecological advantage.

Hatfield et al (1972:209-225) describe measures necessary to protect fish stocks during pipeline construction in northern Canada. Many of the problems discussed are identical to those generated by highway construction and the measures to be taken for protection are the same.

Wildlife

The coming of a highway influences wildlife populations in two ways. First it preempts acreage which would otherwise continue to support wild birds and mammals; this may be a relatively small factor or it may be important depending upon the species affected. Wild land areas in the North are vast, and even relatively scarce plant and animal communities are present in thousands of acres. The land removed from production to serve as a highway right of way is relatively small. Even a 100 foot right of way occupies only about 12 acres per mile. Thus it is viewed that the land removal arising from the Mackenzie Highway should not present a problem from this aspect except in local situations that should be avoided.

An exception may be found where particularly rare plant assemblages, such perhaps as preglacial relics, are found also to support unique populations of invertebrates and perhaps also small mammals. The Department of Agriculture has explored the Arctic insect fauna extensively and the National Museum of Canada the biota and may be able to provide details of specifically sensitive areas. Our concern is – have these agencies been asked to provide input that could be helpful in doing a superior job of planning this new highway system?

A second way in which the intrusion of a highway may be of importance to wildlife species is by the introduction of disturbance. Caribou, for instance, use traditional areas as their calving grounds, and though it is known that some herds alter the calving areas from time to time, there is strongly suggestive evidence that the special requirements they seek are limited in area and in distribution. In the same way certain birds, such as for example, whooping crane and peregrine falcon, have highly specialized nesting requirements and are likely to be most intolerant of disturbance. It is a matter of record that wildlife, large and small, seen in abundance along the Alaska Highway 20 years ago is now infrequently encountered.

Parts of northern Canada are the last refuge of a number of species of wildlife that are rare or vanishing elsewhere. Several of these are wilderness species that have survived in the north because of its remoteness. Such species are intolerant of disturbance and often require large unbroken areas of undisturbed wilderness to survive. The proposed highway route does not traverse areas important to caribou, or to the whooping crane. We presume that it has been routed so as to avoid traditional sites of falcon eyries. These sites have been documented by the pipelines study.

A very important aspect of disturbance is the access that the highway gives to those whose respect for wildlife is indifferent or negative. There are those who will go to great lengths to raid the eyries of the peregrine falcons and gyrfalcons, or use any large white bird as a target. It can be argued that these are really problems of management, dependent upon adequate enforcement of protective regulations. Unfortunately it has been proven virtually impossible to protect individual locations that are rendered easily accessible by the near presence of a road. For this reason careful consideration is urged in routing so as to avoid creating wildlife problems that can be avoided by effective planning.

A third influence is the introduction of new opportunities for fires to occur, destroying the habitat for many plant and animal species.

A fourth influence of the introduction of a road is to create habitats that have not previously existed, and even to stimulate the growth of a lush and nutritious pioneer type vegetation where older associations of lower nutritive quality existed before.

Egler (1957) has referred to the wildlife values that can be fostered by the effective management of vegetation on highway rights of way. A cleared strip of disturbed ground extending for many miles through spruce forest for example, can give rise to increased populations of certain microtine (field-mouse-like) rodents, and also the predatory species that feed on them, it can provide for many miles of forest edge which, in many circumstances, results in an increase of deciduous vegetation which may, in turn, attract nesting of species of birds not previously present, may encourage the presence of sharp-tailed grouse or willow ptarmigan during migration or in the winter, and can supply new food sources for a moose population.

The road embankment also may introduce a new niche into environments where permafrost predominates or where ground is saturated with water throughout the year. In mountainous country ground squirrels, chipmunks, pikas and marmots often find suitable habitat in the embankments, especially those where broken rock of varied sizes has been used. In permafrost terrain, ground squirrels often find artificial embankments suitable as den sites and can use them to extend their distribution. Thus not all influences of the coming of a road are likely to be destructive to wildlife species.

Another effect of a roadway through wild land is the direct hazard to wildlife species using the lands close to the road.

Most species of birds and mammals occupy an area of land that provides them with all the elements needed for survival, and in most cases also for reproduction. The size of the home range used by a species may vary from a fraction of an acre or less for some small mammals to as much as 500 or 600 square miles for some wolf packs.

Small mammals inhabiting the actual right of way may be killed by being crushed or buried during road construction but because the area is relatively small the influence of this on the population of such species is likely to be negligible. Many of the larger species can adapt to the disturbance introduced by vehicles passing along a road, but will frequently expose themselves to accident as they move back and forth across the travelway. The extent of the hazard depends in large part upon the width of the travelled surface, and the density of traffic. Many mammals disappear from the areas alongside heavily travelled highways.

Alternatively, the attraction of deer, moose or other large mammals to the vicinity of the road can introduce a considerable hazard to the road user as well as to the big game species. This is particularly so in deep snow country where the plowed roadway offers an easy path of movement to snow-hampered big game.

Fencing the right of way is seldom a satisfactory answer to the problem presented by wildlife on the roadway. Fences to restrict the passage of deer need to be about 7 feet high;

moose and buffalo will break down ordinary fences, and moose jump them. Caribou can be easily fenced. On the other hand a fenced highway may be denying wildlife access to essential parts of their range, and thus effectively destroying the population. We are concerned to know what provisions have been included in the plans for the Mackenzie Highway to reduce harmful influences and to cope with the changed management situation.

Inventory of Species

An inventory of a number of wildlife species that are either rare in Canada or are of particular concern for other reasons may serve as a check list for use during the preparatory studies for this new road. The point has already been made that most northern species of birds and mammals are not so vulnerable to the environmental changes occasioned by road building as to suffer significant alterations in total numbers. The number of species requiring particular attention is small.

It may seem strange to some that great emphasis is given today to the demanding mission of maintaining in existence populations of creatures endangered by our past or present activities. None the less it is so and great public sentiment in the interests of preservation and restoration of endangered species can be mustered. It is a wise planner who recognizes this concern in the promulgation of road development.

Birds

The trumpeter swan, peregrine falcon and gyrfalcon are species of birds nesting in parts of the Canadian Arctic or Subartic adjacent to the highway route and in need of special concern.

The Trumpeter Swan is no longer an endangered species but its total population is probably less than 3000 individuals. More than half of these nest in Alaska and northern Canada. Only a few nesting areas are known in this region and many more remain to be discovered.

There are only a 'handful' of nesting locations known adjacent to the Mackenzie Highway route but they are recent in origin and may indicate a spreading of the population; perhaps even a return to ancient watering grounds.

Little is known of the factors which limit its population. Indeed it may be that the capacity of the winter feeding grounds is more important than conditions on the breeding grounds. The extent to which the northern population can tolerate the presence of people and traffic close by a breeding lake is also not reported, but the experience with captive breeding and with the populations in Lesser Slave Lake and on Red Rock Refuge leads us to suggest that this swan is not very sensitive to intrusion. None the less it would be the path of wisdom to avoid routing a road close to a nesting lake, or to refrain from developing access and facilities that might encourage intrusion. If close passage of a road is inevitable the new situation must be recognized by those responsible for protection of the species and plans drawn for effective regulation of uses such as power boating and fishing from boats, that could disturb the birds during the nesting period.

Peregrine Falcons have suffered serious decline in numbers throughout most of North America. In large part this is probably the consequence of insecticide poisoning that arises from the position these birds occupy on what is known as a food chain.

Another hazard to the large falcons is the active demand for yound birds to train for the sport of falconry. There is a very heavy demand for birds on certain foreign markets with prices so high that there is strong incentive for illegal taking of the nestlings.

The race of peregrine inhabiting Arctic Canada is one of those seriously depleted and in most urgent need of all the protection that can be mustered. The peregrine falcon usually nests on cliff faces, selecting relatively inaccessible ledges. In northern Canada most of the known eyries are on the faces of canyon walls along river course. About the only contribution the road designer can make to the continued survival of this species is by routing new highways so as not to expose the birds to increased disturbance, and increased danger of vandalism. The Canadian Wildlife Service maintains an inventory of known nesting sites and can provide guidance on this mattter.

The Gyrfalcon is the world's largest falcon. It has the distinction also of occuring in several colour phases – the most spectacular being white with black flecking. Unlike the peregrine this species nests almost exclusively in the Arctic in both the "old world" and the "new world". There are no data that indicate clearly whether or not the numbers of this bird have altered in recent years.

The gyrfalcon is less migratory than the peregrine and thus is not as exposed to pesticides as that species. Furthermore, its food preferences are different and again reduce exposure to the toxic agricultural chemicals that have plagued the peregrine.

However, evidence suggests that it is even more vulnerable to disturbance during the nesting season than is the peregrine. The species is protected under Canadian law with a few permits issued to take live birds for falconry. Here again there is strong incentive for poaching. If possible road routes should be designed so as to avoid known nesting sites.

Waterfowl The Mackenzie Highway will probably have little direct effect upon the waterfowl that use the Mackenzie Valley as a flyway. However, it will inevitably introduce much greater travel to the area and thus the potential for increased disturbance of wildfowl. This will be of limited importance except for the islands in the river in the area north of Good Hope and in the local areas that become ice free early in the spring. These are believed to be essential to the northbound spring movement of the migrant flocks. Here they rest, feed, and undertake courtship and pair formation preliminary to their arrival on the nesting grounds.

Many of the species are operating on a very narrow margin of time in which to bring their young to full flying strength before autumn weather forces migration. Any disturbance that delays the completion of the cycle can be serious if repeated year after year.

Mammals

Northern mammals that should be considered during the planning of roads into new country are barren ground caribou, woodland caribou, muskox, Dall sheep, barren ground grizzly, polar bear and wolverine. Most of these will not be involved with the Mackenzie Highway. There are also some relatively rare species of small mammals such as chestnut-cheeked vole and one or two other short-tailed mice found only in subarctic, arctic or northern mountains. However, too little is known about them to permit designation of areas of occurence and in any event, on the basis of what is known, it would be difficult to maintain that a road would be likely to interfere with the abundance of these species.

Woodland Caribou The status of this species in the Mackenzie Valley is not clear. Banfield (1961) has indicated the probable existence of scattered populations in northern Canada. No recent reports have been found of the status of this species in the Mackenzie District where they formerly reached as far north as Colville Lake and into the forested area south and west of Great Bear Lake as well as along the south western shores of Great Slave Lake.

There is little or no information on the status of this form of caribou early in the penetration of northern Canada by Europeans. Thus it is difficult to comment on the influence that opening the area to more extensive use has had on its numbers and distribution. The general impression is that the species was formerly much more abundant than it is now. It seems likely that overkill rather than destruction of habitat by fire or logging, disturbance by human activity, or an increase in natural mortality, has been the cause of decrease.

This caribou is local, relatively scarce and not very mobile, and is unlikely to pose much problem to the highway planner. However, its rarity suggests concern. Detailed local knowledge will be necessary to give appropriate consideration to this concern.

Grizzly Bear This is one of the rarest of North American large mammals. Macpherson (1965) reviewed the status of the barrenground race. Cowan (1972) brought the information up to date. The systematics of the grizzly bears is poorly understood, thus it is not possible to say whether the bears of Arctic and forested parts of Yukon Territory are of the same geographic race as those of the area east of the Mackenzie River. In general it can be said that the grizzly is relatively abundant in the Yukon but scarce in the Keewatin and Mackenzie Districts where the total population probably does not exceed 1000 (Macpherson 1965).

The grizzly is a wilderness animal relatively intolerant of disturbance. The individuals roam over very large ranges. Thus a highway through occupied grizzly range is likely to influence animals covering an area perhaps 30 to 50 miles on each side of the road. This is to say that a mile of road may spread its influence over 100 square miles.

The grizzlies are hibernators, spending five or more months in an excavated den dug into some well drained bank, or in a natural chamber. In wet tundra or in terrain such as on the Mackenzie Delta, denning sites may be scarce and influence local distribution. Being well drained and free of ground ice, such denning sites may be attractive also to the road builder.

These bears have a widely varied diet, and, when unmolested they can develop the garbage habit and thus come into close contact with man under circumstances likely to lead to attacks, with the predictable outcry against the bear.

The very wide ranging habits of this species make it most difficult for a road through bear habitat to avoid interfering with the species. During the noisy phase of construction, experience in the Rocky Mountain parks has been that the bears withdraw from the highway area. If this denies the animals access to important and thinly distributed food resources the overall consequence can only be a reduction in numbers.

Such resources might be, for instance, a concentration of fish at a shallow spawning area, or an area below a difficult river crossing where caribou frequently drown. If such areas are identified in advance it may be possible to bypass them by careful route selection.

Good camp sanitation during the construction period will minimize the chances of human injury.

Wolf To many Canadians the wolf is becoming a symbol of true wilderness. The pace of exploitation of the hitherto relatively unspoiled parts of Canada is leading to increased concern for the survival of areas sufficiently large to support viable populations of wolves.

At the same time, experience in Jasper National Park, Mount McKinley Park, Alaska, and in the Algonquin Park Area of Ontario has made it plain that it is possible for wolves and man to co-exist in relatively close contact, provided that the food animals remain in adequate abundance, and provided also that the wolves are not shot at whenever they are seen.

In much of northern Canada the wolves feed predominantly upon caribou and moose. If these animals remain in abundance, and the wolves are not molested, they will remain. It seems probable, therefore, that there is no essential reason why a highway *per se*, should lead to a reduction in numbers of wolves. A grid of roads would be a different circumstance. The problem then becomes one of appropriate regulation of human behaviour along and adjacent to the highway. We would reassert the suggestion of a refuge strip paralleling any major northern roads and prohibition of hunting from power vehicles. Native trappers could be excepted.

Wolverine The wolverine is the rarest carnivore in Canada. It is widely distributed in the western mountains and in much of the northern forested region and adjacent tundra, and though nowhere abundant, it is not an endangered species (Rausch and Pearson 1972).

Nothing is known of its scarcity nor of the factors that limit its population, thus it is most difficult to suggest ways in which road construction might be harmful to the species, or to propose any general principles that might reduce such influences.

It is an animal of wilderness country but whether this is because it favours the kind of terrain for which man has found little incentive to 'develop' or whether human disturbance leads the animal to withdraw, is unknown. The former is suspected.

Wetlands and their Wildlife

Northern Canada has few wetlands as rich as those characterizing the more southerly parts of Alberta, Saskatchewan, western Manitoba or the Cariboo parklands of British Columbia. Nonetheless, there are areas relatively rich in such wetland wildlife resources as nesting waterfowl, muskrat and mink. The Mackenzie Delta, the Athabasca Delta and adjacent water bodies, the Rampart River area west of Fort Good Hope, are well known to biologists and natural resource geographers for their rich yields, and other less spectacular areas occur here and there throughout the region. Beaver are more widely distributed.

Wetlands can be easily altered by changes in water level, water regimen and silt content. They are also highly vulnerable to pollution. All such alterations from the original state are of consequence to the wildlife and thus to those who depend on wildlife for income or for recreation.

Fortunately such delta areas are not usually attractive to the road designing engineer. The message is that such areas should be given every consideration before alteration of the local environment is decided upon. Even a relatively temporary withdrawal of water by diversion can have widespread effects, as can the introduction of silt-laden water from road drainage into lakes, ponds and streams otherwise clear.

Scenic Resource Roads

There is no reason that any road cannot be attractive as well as functional. Indeed this is one of the major challenges to the road planning team of today and the foreseeable future. An increasing number of people who use highways would willingly forego a few miles per hour for a more beautiful road environment. The Mackenzie Highway is probably contemplated primarily as a high-speed transportation route. For some of its length, however, it has potential as a scenic highway and even though it is unlikely to attract much tourist traffic for many years ahead, compromise in design and location is indicated.

As roads in the Canadian north, or elsewhere into our wild lands, are in the early planning stage, an associated team should be assigned the task of identifying those areas with the qualities likely to recommend them for future parks, wildlife refuges or similar forms of recreational use. It is generally recognized that the steady increase in the population on this continent, along with the growing interest in wild land recreation, is going to require the setting aside of many new areas where this form of use has priority. Major highways through parks create many problems, both for those who

administer the parks and for those responsible for the development of an adequate system of highways. The experience in Banff and Jasper National Parks has provided many examples of conflict of interest.

The highways are routed through the low valleys, eating up significant amounts of acreage of the low elevation grasslands and parklands that are needed to carry wildlife stocks through the long winters. The result is direct injury to wildlife and damage to vehicles on the roadway. Roads act as corridors for the invasion of foreign weeds and they create problems of access control and repeated discord over continuing enlargement, re-routing and upgrading; they divide natural wildlife ranges and introduce heavy traffic without park concerns into an otherwise peaceful and natural setting. It is the path of wisdom therefore to avoid prime park areas in planning the construction of new transportation arteries. The special purpose roads required to serve the parks can be designed for the single object of providing access to the scenic and recreational opportunities.

The scenic resource road has unique objectives that introduce constraints unusual to the planning of roads for the primary purpose of moving goods and people. Some of the concerns that should play a major part in the routing and construction of roads are:

1. The primary object is to design the route that will present the maximum scenic – recreational experience compatible with budget constraints. Roads have a quality of permanence that requires very careful consideration of route, gradient, alignment, scenic, environmental and ecological factors; correcting mistakes by re-routing leaves scars of long duration as monuments to the errors of the engineer responsible for the original specifications. In many ways it is better not to build a scenic route than to do an inept job of it for reasons of economy.

   As Ryan (1965) has pointed out – beauty along a highway must be deliberately sought. It seldom comes by accident. The pre-study of scenic and ecological opportunities requires particular care as a preliminary to route selection. The inventory should be the basis of a study of how best to present these resources to the viewer.

   In general, roads should avoid long runs along cleared lake shores or river banks. The framed view, or lake glimpsed through a thin screen of natural vegetation, is usually more effective. Turn outs for viewing offer real advantages of safety when a highway carries busy traffic. Filling of lakes, the construction of causeways, the canalization of streams and similar destruction of natural features are all to be avoided. The road landscape architect and ecologist familiar with the local scene can provide many detailed specifications for each contemplated road.

2. Opportunities for wildlife viewing can be frequently developed as major features. The moose meadow, skirted just within the fringe of trees, the mineral lick, the rocky outcrop used by sheep or mountain goat, the beaver pond, or the talus slope occupied by hoary marmot and pika, are all components in the opportunities to be developed. Along with these will be the unique vegetative form, muskeg, marsh or alpine meadow and the majestic views. The vastness of the boreal forest as seen from a small eminence, the infinity of tundra ponds, eskers, pingos and other features of northern landscapes are just a few of many features.

3. Where scenery is a special feature, low speed should be designed in, with all that this introduces in departure from accepted highway standards of right-of-way width, clearing, grade and curve alignment. These concepts may be incompatible with the primary objectives of the Mackenzie Highway to carry commercial traffic. However, it may be practical to have scenic detours for the use of the many tourists who will undoubtedly use the road in summers.

4. Such roads should include frequent stop opportunities with pullouts into screened spurs where quiet viewing is possible. Auxiliary features such as short walks, or trail termini, off-loading facilities for small boats, and information centres, can be among such planned features.

5. When special features are available, there is a general view that circle routes are preferable to blind-ended roads planned to give access to a single feature only. However, the decisions will certainly involve the desirability of entering a road into yet another area of wild land, as well as the availability of a suitable route.

6. In general, service lines should not follow the roadway. Even though having the lines in view may facilitate maintenance it introduces yet another foreign feature.

7. Fencing is completely inappropriate unless it is of special importance in small areas to control snow or sliding scree. Even then, alternative possibilities for handling the problem by less obtrusive means should be sought.

8. Only native vegetation should be used for soil stabilization and restoration.

9. No chemical treatment of the right-of-way strip should be permitted, and only minimum clearing should occur. The verge is wildlife terrain.

10. The matters of borrow pits and construction camp grounds or vehicle parks become of particular importance. In general they should be elsewhere, even if this increases construction costs somewhat.

Conservation and Roadways

The sensitive and effective insertion of a road into wild land begins in the planning stage with the series of inventories of opportunity and restraints.

From these will emerge the specifications and cautions that are to govern the selection of the route to achieve the nearest approach to what is desirable from the standpoints of economics, engineering requirements, and environmental concerns. Inasmuch as the wildlife and other ecological values are probably irreplaceable they wil often emerge as the dominant considerations.

Only the experienced road engineer can adequately develop the specifications that should govern the physical details of construction. However, he can profit by the statement of certain environmental concerns that will provide input that he can develop into engineering detail. V.D. Hawley (1971) writing in the Northern Roads Task Force Report refers to damage seen by him during inspection of the Yellowknife Highway and the Ingraham Trail, both in the Yellowknife area. This treatment is a useful one because it provides specific detail that can be developed into generalizations.

Hawley cites McCardle (1960) as follows: "Elements which oppose the soil-water objectives of watershed management include (1) waterproofing of road surfaces, (2) quick drainage of road surface, shoulders and roadside ditches, (3) deep incision of the soil mantle which intercepts surface flow, (4) cut and fill slopes which, unless quickly stabilized expose soil and subsoil erosion, (5) artificial channels (roadside ditches) which intercept and quickly concentrate surface runoff from uphill slopes." The first two of these may be seen as essential to the maintenance of a good highway even though they introduce other problems.

Road Alignment It is usual today to attempt to achieve as nearly as possible flat alignment of a road, eliminating as many hills and hollows as can be levelled by cut and fill. Hawley refers particularly to enormous amounts of fill used to attain a nearly flat roadbed at river and creek crossing. These resulted in extensive erosion from the fill slopes, as well as in alteration of stream channels. Specific reference is made to statements of Jacks and Whyte (1956) who report that erosion loss can reach 100,000 cubic yards per mile. Such erosion is likely to have very adverse effects on fish and wildlife occupying downstream habitats. It may well alter stream behaviour downstream. It is suggested "that approaches should conform more to the topography and the structures installed should bridge the stream rather than force the stream to alter its conformations." Engineering design to avoid these problems is relatively easy but may cost more initially. Once again we return to the necessity of recognizing the cost of good environmental planning as a legitimate cost to be included. It may be that the long run cost will be no greater and possibly even less.

Clearing It is traditional to clear rights-of-way to uniform width, regardless of slope, substrate or conformity. This is neither necessary nor desirable. As we understand it, clearing the broad strips bordering highways is largely for reasons of safety. Unfortunately, the practice seems often to be applied as a matter of routine, even when it is not contributing to safety. Verge clearing of uniform width can lead to a dull and uninteresting road, driver boredom and resultant accidents. Unless snow control, visability, dust control, quick drying or other important concerns dictate, clearing should be kept to a minimum. Even trees can be brought in close where uphill slopes act to deflect any vehicle leaving the road before it can collide with the trees, and where visability is not a concern.

Trees can be left where they do not conflict with urgent requirements. Shrubs, herbs and grasses help reduce erosion, add to the beauty of natural vegetation and return the right-of-way in some part to its function as wildlife habitat.

Such selective management of roadside vegetation requires judgement rather than the unthinking exercise of a routine procedure. But the basis for such sound judgement is available and the results will be worth the effort. Chemical spraying may be appropriate in some regions, but it is a "shotgun" process of unknown consequence in northern vegetation. Spraying should be selective and should be used only where it can most effectively serve the total objectives of the road and its right-of-way without reducing overall values and imposing unacceptable ecological and esthetic consequences.

Another problem frequently encountered in road construction is pushing excavated earth against tree boles. Most coniferous trees are killed by this treatment and contractors should be suitably instructed.

Disposal of Debris Debris from right-of-way clearing around construction poses a major problem. It is frequently piled and burned on site or removed for piling out of sight of the highway. In some jobs burying is resorted to.

Hawley recommends windrowing in the centre of the cleared right-of-way and burning. This has been satisfactory in the few instances we have examined but may not be the universal best answer. We are uncertain of problems that may arise in the tundra areas.

There is plenty of engineering 'know how' concerning the serious consequences of destroying or compacting the surface insulating layer of organic soil and vegetation where the substrate contains ground ice, the details need not be referred to here. Piling and burning the shrubby growth or timber debris on the right-of-way would be a mistake. Indeed the entire treatment of roads and rights-of-way on tundra and ice-rich soils requires a specialized series of procedures.

The length of time that spruce and some other coniferous tree debris can be left on the ground before burning has important impact from forest insect control experience. Such slashing, if left too long, can initiate devastating outbreaks of bark beetles that spread from there into healthy trees.

Where only lightweight vegetation is involved, mechanical chippers can dispose of it efficiently, returning the chips to the ground.

Cuts and Fills These are extremely vulnerable to erosion and require special treatment. There is strong tendency for the engineer to accept steeper slopes where cuts and fills are deeper or higher. The cost factor may dictate. The longer slopes are especially vulnerable to erosion loss because of the amounts of water they collect downslope. Differences are gradual and result in dramatic difference in erosion losses, depending, of course, upon the nature of the material involved. Hawley (1971) cites experiments by Dickerson and Richardson to the effect that a steep side slope of 1.3:1 lost 237 tons per acre per year, reducing the slope to 1:3 reduced the loss to only 79 tons of soil per acre per year. In addition to the reduced soil loss achieved by flattening the slope the rate of revegetation will probably be greatly improved.

The obvious disadvantages arise from the cost of moving more fill; and, if the fill is not coming from cuts, of larger borrow pits. Even though the equation is complicated, erosion is never desirable and if it results in silt-loaded drainage water that must be settled before it can be discharged into natural drainage, there are cost gains here too, to affect the cost of decreasing the slope during initial construction.

Further gains can be achieved by allowing the alignment to conform more nearly to the natural topography so that excavation and fill are minimized.

Many engineering treatments are known for reducing soil movement down steep cuts or embankments. In general, the ecologist favours the encouragement of the regrowth of natural vegetation. Benching might have advantages in both objectives, reducing erosion and facilitating revegetation.

Disposal of Spoil The most frequent source of spoil is the construction of drainage ditches to gather water from the roadway itself, to reduce the water content of the subsoils or to remove the water from the vicinity of the road. Cuts in ice-rich soils also provide large quantities of material that has to be wasted. The frequent recourse to collecting water from considerable lengths of roadway and discharging it into a natural drainage channel may or may not be satisfactory from the standpoint of environmental concerns. Especially where new construction is involved, drainage water is heavily silt laden and discharge of this into clean waters can be expected to have important and long lasting consequences. If the receiving water is already silty the outcome of additional silt burden may not be of as much importance and may even be of no consequence. The precise situation will require study on site.

Hawley has the following report to make on his observation: "The drainage systems seen on this inspection were obviously designed for the sole purpose of removing water from the vicinity of the road. Little evidence was seen to indicate that there may be further consideration of the fate or effect of the directed water. Many instances of improper drain placement, design, construction or maintenance were recorded. The most shocking practice was the termination of drainage ditches in creeks or lakes after feeder drains had intercepted (for miles) water coming downslope or off the nearly waterproof road surface. The unusual amounts of water so collected must drastically alter the stream hydraulics and severe erosion is probable in almost all instances." Kraebel (1936) states "The most important problems in controlling erosion on present mountain roads are the improvement of drainage and the stabilization of the slopes by vegetation." Drainage must be planned and engineered not only to remove unwanted water from the roadway and to protect it from damage, but also, so far as possible, to return that water to the natural system in a natural manner, without damage and without causing erosion of precious soil in transit.

Borrow Pits Obtaining the supplies of road building material often presents serious problems in northern Canada. River beds sometimes offer an apparent source of supply and there are some places where this may be used without damage to the local ecosystems. In many places, however, these sources cannot be used because of the attendant silt production, alteration of stream flowing characteristics, or the destruction of spawning beds. In some other areas the extensive gravel bars are of importance to mustering flocks of snow geese. Sources of such potential material should be the subject of inquiry at each site. Kevan (1971) has rightly stated that "gravel should not simply be regarded as a ready made material for man's use". It is important to the survival of many forms of wildlife, spawning beds for fish, den sites for ground squirrels, foxes, wolves and even bears. These uses are frequently important only in small, localized areas and avoiding them need not be a matter of great cost.

Borrow pits are the usual source and these present various problems depending upon such local circumstances as depth of soil over bedrock, physical composition of soil, amount of top soil, water table, nature of surrounding vegetation.

We have no information on the special problems that may arise on frozen soils of high ice content, but the basic environmental objectives remain the same.

Where soils are shallow over extensive areas of bedrock, erosion is likely to be severe, exposing even larger areas of rock and dumping the silt into local lakes and streams. If the content of fine particles in the remaining soil is high, a surface pavement frequently arises as a consequence of snow melt and puddling by rain. This may increase the rate of runoff and seriously restrict revegetation (Osborn, 1955).

Borrow pits need not be long term defacement of the landscape. They can often be restored to natural contours and revegetated or they can be designed so as to be productive of wildlife and scenically acceptable. Thought should be given to the rehabilitation during preparation of plans for the pits. Top soil should be saved for respreading.

There are excellent examples of the successful treatment of borrow pits on the reconstructed part of the Alaska Highway from mile 200 to 225. Such requirements should be included in specifications.

If water will accumulate in the pit, or the drainage can be arranged to bring water to it there are good possibilities of producing an attractive pond which may serve as a focal point for ducks or shorebirds. If this is a possibility the pit should preferably have irregular outlines and the area should be 4 – 5 acres or more and 8 feet deep or better. If a small island or two are left unexcavated, potential attractiveness to wildlife is increased.

Final steps should be grading the surrounding banks and respreading the top soil. Natural vegetation may occur quite quickly, or some assistance in the form of fertilization or seeding may be needed.

Obviously if these opportunities for reclamation of borrow pits are to be developed fully, it should borne in mind from the outset that the borrow pit is part of the environmental impact and as such its selection, development and treatment requires detailed attention. Potential for reclamation becomes an element of choice of a borrow pit site, not just accessibility.

Campsites Construction campsites should be selected to provide opportunity for concealment from the travelway and appropriate substrate for sewage treatment, drainage, vehicle parks, and other unavoidable concomitants of construction involving large numbers of men and equipment. Here again clearing should be kept to a minimum, debris should be carefully disposed of, edible garbage should be handled in such a way as not to constitute an attraction for bears and indestructible garbage should be removed or compacted and buried with preparation made for revegetation of the disposal site.

It should be a matter of prior stipulation that a campsite is cleaned of all building debris and equipment and restored as nearly as possible to original state before the job is regarded as complete.

It is particularly important that the highest standards be set on jobs done for or by the Government of Canada. It should aim to establish the principles and practices to set the standard to be met by other jurisdictions and the private sector.

Revegetation It is most difficult to discuss in general terms the matter of rehabilitation of disturbed areas of northern Canada, with re-establishment of the native vegetation. Soil types run the entire gamut from drifting sands along shores of some larger lakes (Athabasca and Great Slave) through relatively mature parkland soils, relatively new and very wet soils of muskeg, wet tundra and some forests, to the unique soils of the frigideserts of such high Arctic islands as Ellesmere. Each situation will have its own problems and opportunities and will require a different approach to revegetation.

There are well known causes of poor regrowth of vegetation on distrubed sites. These include steep slopes, 'scalping' of topsoil, compaction, pavement formation leading to accelerated runoff and poor water penetration.

Bliss and Wein (1972) have discussed a number of the problems faced in the restoration of vegetation on tundra soils and have referred to some of the experiments in progress. Much additional information is arising from research work in progress in connection with preparation for the installation of pipelines in the Arctic.

They point out that plant establishment is intrinsically difficult in a climate where plant growth is slow and where the growing season is only 50 – 80 days. In the low Arctic, seed production is meagre and irregular and plants depend more on vegetative methods for reproduction. This process is even more pronounced in the high Arctic. They report that in the high Arctic disturbed sites often remain devoid of plant life for much longer than is the case further south. They find also that the frigidesert soils of the high Arctic are relatively more resistant to the passage of vehicles than the soils of the low Arctic terrains, provided that operations over them do not take place while they are damp.

Many problems encountered in the re-establishment of plants along roadways arise from inept maintenance practices that reveal little concept of the desirable end product.

Hawley (1971) refers to the practice of periodically scraping all plant life from the right-of-way with a bladed vehicle. This makes sense to the road maintenance crew. Such treatment reduces the vegetation control action needed. However it is undesirable from an ecological viewpoint and probably also in an engineering sense.

The same can be said of the spraying of roadsides with phytotoxic chemicals that annually deface thousands of miles of Canadian roads. This is conducive to the development of grass and the elimination of shrub growth.

Decision is required on the nature of the potential plant cover best suited to soil protection. Egler (1958, 1957) suggests that short shrubs are usually the most desirable kind of cover to seek. His reference is to more southern climatic areas but the same may prove true for much of the forested area of northern Canada. Ross and Wein's experiments have involved studies of different native grasses.

The point to be emphasized is that roadside treatment should be aimed at producing the kind of vegetation that is most desirable from the standpoints of control of erosion, the maintenance of sight distance for safety, encouragement of wildlife and enhancement of highway beauty.

Route Selection There are many criteria of importance to the engineer that go into the selection of a highway route. There are also those that are largely motivated by political or economic consideration.

Those experienced in the construction of roads in Arctic environments have developed many clues of a geological and ecological nature to provide guidance in route selection.

Once the decision is made to connect two points by road or to penetrate into wilderness areas, route selection is the first field of activity. Topographic and aerial maps are extensively used in selecting tentative routes but field experience is helpful to the initial study. In Alaska route selection to take advantage of non-permafrost terrain or avoid obvious patterned ground is extremely important. Permafrost adds another dimension to route selection in addition to those needing attention in more temperate regions.

South slopes may be free of frost, especially near ridge lines and poorly drained low ground is usually high in frost or ice. Aerial photos are valuable aids in these early stages of route selection because patterned ground as an indicator of ice is easily seen and avoided. Vegetation can be used by an experienced interpreter to indicate drainage conditions, and with caution, gain some insight into general soil textures. No form of remote sensing, however, can pick up permafrost or ice masses in un-patterned terrain, and guarantee that a selected route will be free of ice.

Obvious problem areas can be avoided during map reconnaissance by using favourable terrain such as ridges which are drier and usually constitute better construction material. Nearly every valley that must be crossed is a potential problem area; therefore, the fewer of these on a route the better. While admitting that one can seldom have all the information one would like, final selection of a route must be done on the ground and numerous borings made to examine subsurface soil materials. It is this stage that ought to be intensive because, if trouble spots are not detected early, costs can rise far above expectations. Money spent on route selection is money well spent. As an example, the TAPS road from Livengood to the Yukon was estimated at 10 million dollars; because of unforeseen difficulties that should have come to light by intensive reconnaissance, it is expected to cost 15 to 20 million dollars.

We are particularly concerned that route selection consider all wild land resources – water, recreation, minerals, timber, and wildlife, to name a few. Planning the route with these in mind will minimize deleterious environmental changes.

We re-emphasize the importance of avoiding the particularly sensitive parts of the environment, wildlife situations of outstanding value or fragility, as well as of bypassing potential park areas.

REFLECTIONS ON LAND USE ISSUES FACING CANADIANS[1]

James W. Maxwell*

INTRODUCTION

The organizers of this meeting should be congratulated for their courage and optimism, perhaps even temerity, in scheduling a session on a subject as comprehensive and complex as "land use in the large", because a broad examination of land use issues inevitably and very quickly raises fundamental questions concerning the functioning of society and the basic societal goals being pursued. When dealing in such heady stuff, it takes little effort to boggle the mind or to get lost in the labyrinth of cause and effect. The relevant subject matter is vast, ranging through the physical, biological and social sciences, the law, business, public administration and beyond. Relationships are dynamic, frequently complex, sometimes indeterminate, and involve all elements of society. Above all, land use issues and considerations are highly political.

Given these factors, it is not surprising that many land use policy workshops end up in confusion, with the participants muttering the ecologist's creed that "everything is related to everything else". Frequently, the only seemly escape appears to be the enunciation of motherhood statements that, while being sound as principles, are most difficult to apply in attempting to change the state of affairs.

There is no question about the difficulty of the challenge to be faced in this agenda topic. Nevertheless, the decision to place land use on the agenda is a wise one and the organizers' optimism is justified. The forum represented by a gathering of environmental advisory councils must be considered one of the most appropriate that could be devised for an effective examination of Canadian land use issues from an environmental perspective. The group assembled here comprises some of the best informed people in the nation on environmental and land use concerns; there is representation from across the country, and the organizations are strategically located with respect to the provision of policy advice to Ministers.

The venue of this meeting, in the historic Qu'Appelle Valley, also augurs well for effective discussion. In addition to offering an excellent milieu for a "think-fest" of this type, the locale has special significance from a resource planning and management perspective. The Qu'Appelle Valley was one of the first river basins in Canada to be the subject of a federal-provincial agreement for comprehensive river basin planning. The plan is now in the implementation stage. It provides an effective operational framework that defines the program and funding responsibilities of a wide range of agencies at all levels of government -- all working towards a common set of objectives to make wise use of the resource base. It is significant that of the $33 million implementation budget, $22.2 million is devoted to environmental improvement and management activities.

If some of the spirit and success achieved in the Qu'Appelle Comprehensive Planning Initiative rubs off on the workshop deliberations, we will be in good form.

A SUMMARY OVERVIEW OF THE LAND USE ISSUES

The task in this session is to provide a national overview of the current land use issues, and to identify key policy questions in need of resolution. This would be a formidable task to accomplish with justice in the time available -- if we were starting from scratch. Fortunately, the job has already been done by the Land Use Task Force of the Canadian Council of Resource and Environment Ministers (CCREM). The Task Force Report, *Land Use Issues Facing Canadians*, serves as the basic reference document for the workshops.

The CCREM Task Force has done a commendable job in providing a systematic and comprehensive review of the nature and consequences of the current land use issues, and the responses of our governments. Though we could easily use the time available to examine in detail some of the many specific points made in the Task Force Report, I will give only a summary review of the concerns and factors, and then discuss a few issues which are relevant to discussions on the policy dimensions of land use.

During the past three decades, Canada has experienced unprecedented growth in its urban areas and in the scale of its resource development activity. In the period 1941 to 1971 our population increased by 87% (10 million people); virtually all the growth occurred in urban places. For most of our metropolitan areas, growth has meant urban sprawl. Sprawl has resulted in high costs for public services, disruption in metropolitan fringe-area agriculture and the loss of prime farmland, increasing energy consumption, congestion in city centres, higher pollution levels, loss of wildlife habitats and amenity resources, deterioration in visual environments, enormous windfall profits -- and wipeouts -- from land speculation, and a loss of sense-of-community. We have developed large subdivisions with septic tank sewage systems on soils

[1] *Presented at the 1977 Assembly of Environment Councils of Canada.*

* Director, Lands Directorate, Environment Canada Ottawa

unsuitable for this purpose. We have built on floodplains, and have had to face huge flood damage bills. In 1974 alone, the federal and provincial governments paid out $60 million in relief for losses incurred on flood-prone lands. We have built on soils and by methods that contributed great quantities of silt to our streams. We have needlessly destroyed many fine stands of trees, only to replant expensive nursery stock in an attempt to introduce a dimension of nature to our instant communities. Above all, we have put in place a form of urban development that is highly dependent on the automobile for its functioning, a form built on the premise that abundant and cheap sources of energy would continue to be available.

Public reaction to the consequences of the pace and form of urban growth, combined with increased public knowledge on the workings of natural ecosystems have led to vigorous demands being made of all levels of government to improve the urban environment and its livability.

The originally urban-oriented environmental and land use concerns of Canadians have broadened to include land use issues in rural and wilderness areas, as a consequence of the increasing number and scale of resource development projects. Projects such as the Bennett Dam with its profound effects on the ecology and economy of the Peace-Athabasca Delta, the James Bay, Churchill Falls and Lower Churchill-Nelson hydroelectric developments, the Douglas Point nuclear station, the proposed Fundy tidal power project, the northern pipeline proposals, the Reed Paper forest development proposal, the Rocky Mountain Foothills strip-mining projects and the development of the Alberta oil sands, have all stimulated debate and heightened public awareness and concern about the land use, environmental and social impacts of major developments in our rural and wilderness areas. So have issues such as the unresolved native land claims and the increasing incidence and extent of foreign and non-resident land ownership.

Less spectacular activities, but perhaps even more significant because of their pervasive and frequently irreversible consequences, are also the subject of concern. Included are agricultural, forestry and mining practices that lead to erosion, deteriorating soil fertility and polluted lakes and streams. Ad hoc incremental development in ecologically important estuarine areas like the Fraser Estuary/Delta can also be considered in this category. The damage caused by these piecemeal and sometimes individually innocuous activities can be equally bad and far harder to repair or remedy than the problems generated by the spectacular developments where the damage and the agents responsible are easily identified.

This review should be sufficient to illustrate the diversity of our land problems and to remind us of the more specific issues raised in the CCREM Task Force Report.

As we look to the future, we can expect that our current land use and management problems will be with us for both the short and long term, and many will intensify in their severity. The energy outlook alone confirms this expectation. Our demographic future and the agricultural land situation also support this view.

To gain an appreciation of the magnitude of some of the land use issues to be faced in the short and medium term, it is useful to look at the demographic trends. Our current population of 23 million is expected to grow to about 30 million by the turn of the century, if net annual immigration runs about 100,000, and there are no surprises in the fertility rate. Most of the projected growth is forecast to occur in our large urban centres. Indeed, the country's 22 Census Metropolitan Areas (CMAs) are expected to account for about two-thirds of the growth. The three largest CMAs alone would account for one-third of the total population growth anticipated for the nation. If this projection unfolds, the proportion of the total population living in urban places will rise from its 1971 figure of 76% to something like 90% or perhaps higher in 2001. It means that the principal urban regions will continue to be the centres of development action in settled Canada. The picture becomes even more intriguing when we look at the composition of the population. The baby boom is coming of age and we are experiencing record levels of household formation. This will continue until the mid-1980s. In accommodating the housing requirements of our boom generation, we will, over the next seven to eight years, build 90% of all the new housing units required to the end of the century. The vast majority of these new units will be located in metropolitan areas. The manner in which this development is accommodated will depend on the land use plans adopted by local governments, and on the relevant support policies and programs of the provincial and federal governments. These plans, policies and programs will have a direct influence on the price, type and location of the housing provided. They will also have a direct bearing on the quality of urban life, including the adequacy of recreation and open space opportunities; on energy requirements for transportation and heating; on pollution levels; and on the viability of metropolitan-fringe agriculture. It is critical that this development challenge be met effectively, for it may represent the last major opportunity to shape and fine-tune the form of our metropolitan areas until sometime into the next century.

An appreciation of land issues that will become more significant in the medium and long term can be gained by examining the agricultural land situation.

Recent analyses by Agriculture Canada suggest that by about the year 2000, up to 44 million hectares of cropland, exclusive of grazing land, will be required to feed the projected Canadian population of 30 million at current standards, and to meet projected international food obligations. Canada has 45 million hectares capable of sustaining crop production.* In 1971, 37 million hectares were devoted to crops. Thus, to meet the projected year 2000 demands, the area already in production must be kept available for future cropping, and up to seven million hectares not currently being cropped must be brought into production. This would bring the country close to the limit of its physical supply of land well suited for cropping under current and projected technology. In addition, the scenario also requires significant increases in foodland productivity. Approximately half the required increase in production is projected to come about through this means. Increasing productivity will require greater applications of energy, fertilizers, pesticides and other scarce inputs. Increased stress on natural ecosystems would seem to be one of the inescapable consequences. Higher food prices is another.

The loss of prime agricultural land to non-farm uses, when viewed within the context of this scenario, assumes considerable significance. In the short to medium term, the loss of these prime lands can be offset to some degree by bringing other land into production. But the lands available for this purpose will be of lower natural productivity and locationally less favourable. In the case of some crops, the alternative lands are climatically unsuitable. Also, this offsetting process will accelerate the need to apply additional energy and other inputs for crop production and transportation. Given our energy outlook and the added stress on ecosystems, this is not a very attractive alternative. In the long term, there may be no feasible way to offset the loss of prime farmland, barring breakthroughs in technology. It may mean that radical changes in our dietary habits will be required, or our role in producing food for the global village diminished.

The potential for losing additional prime farmland is considerable because of the location of this key resource. Approximately 54% of Canada's Class 1 agricultural capability land and 30% of the Class 2 land is located within 50 miles of the 22 Census Metropolitan Areas. It is in these metropolitan fringe areas where commercial agriculture is experiencing the greatest advese effects arising from urbanization and where the greatest conversion of farmland to other uses is occurring. Threats to good farmland in the rural West will also increase, as the incidence and extent of strip-mining for coal increases.

Should these issues be viewed as national concerns, with Canadians demanding concerted action by all government levels? Or should we continue to rely on the provinces to deal with the matter, each in its own way? These are interesting policy questions.

This glimpse into the future is very cursory and incomplete but is intended to impart some sense of urgency concerning the need to address the issues.

LAND USE & GOVERNMENTS

When we examine the relationships within and between governments with respect to land use, we find a web of linkages and impacts that is clearly as complex as the land use problems themselves. Indeed, in the minds of many citizens, it is this almost unfathomable web that is "the land use problem".

From a constitutional perspective, the situation appears to be more or less clear-cut. Provincial governments have exclusive legislative jurisdiction over the general regulation and control of land use within the provinces. The federal government has exclusive legislative jurisdiction over the territorial lands, and proprietory rights for federal lands located in the provinces. Both government levels have delegated some of their authorities over land use and resource regulation. In the case of the provinces, to local governments; in the case of the federal, to the territorial governments.

The clarity suggested by the constitutional allocation of power and the delegation of authorities, disappears very quickly when we begin to examine the potential of the three government levels to influence the use and management of the land resource. We find that the government level "on the front line" in facing land use issues in settled Canada – the municipal/regional government – has the smallest arsenal for tackling the root causes behind the issues. Local governments have the ability to influence the location of activities within the overall land use pattern of their jurisdiction. This can be done by adopting official plans implemented through zoning and other measures. To some extent, they can also influence the qualities of the land-using activities through building codes and peformance standards. Local governments, however, do not have jurisdiction over the strategic policy levers that can be used to influence the overall rate and nature of growth and land use change. Many of these levers rest with the provincial governments and concern domains such as provincial transportation and resource development policies. Because of their jurisdiction over land use and many of the strategic policy areas that impact on the land resource, the provinces are in a key position to influence the direction and nature of land use change. The considerable potential

* Canada Land Inventory agricultural capability classes 1, 2 and 3

of the provincial governments to identify and achieve good land use is well documented in the CCREM Task Force Report. However, the story does not end here.

It is becoming increasingly apparent that the policy levers and proprietory rights of the federal government also have major impacts on the nature and direction of land use change and the quality of land management. Through its immigration, fiscal, housing, regional development, transportation, agriculture, energy, environmental and other policies, the federal government generates pervasive direct and indirect impacts on the land resource. The use and management of federal lands, – 90,000 hectares of which are strategically located in metropolitan areas – also produce significant land use impacts.

In the past, consideration of the federal impacts on land use have not always received the attention they deserve. There are reasons for this: the absence of an explicit jurisdictional responsibility at the federal level to consider general land use concerns within the provinces; the single-minded thrusts of federal programs to achieve sector-specific objectives; the absence of well articulated and widely known provincial development and land use objectives, strategies and plans that could be used as guidelines in delivering federal programs.

It would take a seminar series to describe the manner in which the policies and programs of all government levels interact to produce land use impacts, and to assess the implications of the impacts. Such an exercise is not necessary, however, to appreciate that many of these impacts lead to major land use conflicts, We need only remind ourselves of the recent controversies surrounding the siting and/or expansion of airports, harbours, pipelines and parks to confirm this notion.

As we assess Canadian land use issues and the responses of our governments to them, we come to conclusions not unlike those reached by the CCREM Land Use Task Force. To use the Task Force words, "in a relatively short time we have evolved to the point where land use and its complex effects permeate the entire fabric of society". Traditional government approaches to land use decisions, based on narrow sector-specific objectives are no longer working. New approaches and organizational arrangements are required to establish broader perspectives for determining land use allocations and monitoring their effects. These approaches must incorporate objectives reflecting local, provincial and national land use concerns and provide for concerted action by all our governments.

Developing the approaches presents a mighty challenge. It requires the creation of a commonly understood information base, the negotiation of mutually acceptable land use objectives within the framework of social, economic and environmental goals, and the formulation of strategies for coordinated program delivery. It also requires devising more effective means of intergovernmental cooperation and public participation in the planning processes affecting land use. The difficulties to be faced in launching such approaches are enormous. We only have to think of the problems encountered by the federal and provincial governments in trying to reach a national energy policy to appreciate this. Yet, if we are to meet the most serious of the land use issues, a cooperative federal-provincial approach is required.

Some progress towards meeting this challenge has been made. Innovations are being introduced by all provincial governments in attempts to broaden their approaches to land use. Many of these initiatives are reported in the CCREM Task Force Report. No doubt, we will be hearing of more in the sessions of environmental impact assessment policy and public participation in planning.

Progress is also evident at the federal level. The comprehensive river basin planning program has already been mentioned. We can also cite the tri-level consultative process which has facilitated cooperative federal/provincial/local government discussions and action in addressing some important urban land use issues – for example, the Halifax waterfront redevelopment program. There is the Federal Land Management Policy, implemented in 1975. This policy declares that, except for Indian Lands and National Parks, all federal lands located in the provinces are to be managed so as to combine the efficient provision of government services with the achievement of wider social, economic and environmental objectives. In essence, the policy is intended to harmonize the development of land for federal programs and services with local and provincial development strategies. It is managed by a Treasury Board Advisory Committee which reviews all proposals for land acquisition by federal departments as well as proposals for changing the use or disposing of federal land.

In addition, an interdepartmental task force on land use policy, established by Cabinet, is currently developing proposals for federal objectives on land use. If these objectives are accepted by Cabinet, they will serve as a basis for federal/provincial discussions and public debate on the subject of national land use objectives and strategies. If a consensus can be achieved on national land use objectives, we will have a framework that all governments can use in guiding their policies and programs that affect land use. In the event that such a consensus is not forthcoming, the federal land use objectives can at least be used to guide the delivery of federal programs that have major land use impacts.

Progress is being made, but much more needs to be achieved. What can environmental advisory councils do to facilitate this progress? There are a number of items that could be considered.

- Councils could urge the senior governments to accelerate their efforts to formulate and adopt national land use objectives, incorporating both provincial and federal objectives and strategies for cooperative actions.
- Councils could recommend that the senior governments join to identify critical lands whose use and management bear directly on the achievement of long term social, economic and environmental goals.
- Councils could urge the senior governments to monitor land use change within the provincial and national contexts. Our governments have already produced, through the Canada Land Inventory Program, a national overview of land capability.

  This program has proven to be of great value. For example, it provided the initial base for determinng the designation of Agricultural Land Reserves in British Columbia. We now need a means to assess the compatibility of land use with land capability. This could be done through a federal-provincial initiative to launch a Canada Land Use Monitoring Program.
- Councils could recommend that an annual report on the use, management and environmental state of the nation's land resource be addressed to the Canadian people. This is already done for our water resources in the *Canada Water Yearbook.*
- Councils could urge governments to provide local and regional governments with better information, more effectively delivered, on the ecological characteristics and use capabilities of land and the socio-economic factors affecting land use. This would promote environmentally sound land planning at the local level and would enable local governments to view their lands within the broader provincial and national contexts.

Other issues, like the ever-changing weights assigned private and public rights and obligations in land have not been addressed. Perhaps a seminar series is indeed required to do justice to the subject. This meeting is addressing a critical topic. *To define and achieve good use of land may well be the most fundamental of all environmental objectives.* As E.F. Schumacher, the maverick economist, has observed: "Study how a society uses its land, and you can come to pretty reliable conclusions as to what its future will be".

ENVIRONMENTAL IMPACT ASSESSMENT POLICIES AND PROCEDURES: CONCERNS OF 1978[1]

D.S. Caverly*

We are gradually moving out of the theory of environmental impact assessment and into the practice. In Ontario, with a legislative framework for the change, this has been a long and involved process necessitating extensive efforts in the determination of what is to be covered by the Act and what is not to be. The first environmental assessments are now rolling into the Ministry of the Environment.

This paper concentrates on certain aspects of the environmental assessment program in Ontario which seem to be the subject of attention by those directly and indirectly involved in the environmental assessment process. Most of these items are not directly related to public hearings, because no hearings under the Environmental Assessment Act have yet been held and it is difficult to determine whether hearings to be conducted by our Board will be a great deal different than at present, under other legislation. We are aware, of course, that more information will be coming our way in the course of the hearings, with the possibility that hearings may be longer and more detailed.

The first area covered is a description of the two types of environmental assessments that can be conducted. The first type is the most familiar – the project environmental assessment. It deals with a specific project or undertaking: a generation station, a coal development scheme, a new highway, a dam, etc. The second type has been developed to cover a class or program of projects. It is an approach unique to Ontario. It would allow a proponent to cover – in one document – a whole series of small projects which have basic similarities and have a generally predictable range of effects which, though significant enough to require an environmental assessment, are likely to generate relatively minor impacts. The proponent would have to meet the same requirements as in a project environmental assessment, such as describing the rationale, the alternatives, the mitigation procedures, etc. The document would outline the planning approach the proponent intends to carry out for each project within a class, but it will likely be done in a more general fashion than the project environmental assessment because the specific details of the projects would not be known. It is also possible that the program environmental assessment might identify subsets of projects within the program which require different kinds of treatment, such as the preparation of an individual environmental assessment.

Two examples of class environmental assessments are those which have already been submitted for review to the Ministry of the Environment. One, by Ontario Hydro, covers construction of minor transmission lines and minor transformer stations. The other, submitted by the Ministry of Transportation & Communications, discusses realignments or adjustments of alignments to rural provincial roads. Both of these class assessments will bear upon changes or additions to their respective systems anywhere in the province. If approved, the proponents, Ontario Hydro or the Ministry of Transportation & Communications, can then proceed to individual projects subject only to the conditions of the given approval.

This class environmental assessment approach is useful and will result in savings in both time and money. However, some difficulty may occur in the attempt to obtain public input and comment. This is especially important from our point of view if a hearing is required.

The Ontario Board has considered that it might be necessary to institute a travelling "road show" to secure public input in various parts of the province. But even with good advance publicity, it is uncertain what level of participation can be expected from the unaffiliated public. As with many developments, until one gets a firm handle on the questions of "where" and "what", it is difficult for the individual citizen to relate and to comment.

Notwithstanding these problems, there are very definite advantages to the class assessment approach. First, there will be the opportunity for scrutiny of programs which are of continuing nature. Second, there will result a set of firm procedures which would be followed each time a type of project is initiated and carried out. Third, there will be environmental controls built in on a continuing basis. Fourth, concern with the net effect of a large number of small projects on the environment (incrementalism) will be eased; and Fifth, there will be a minimization of the resources needed to assess and monitor each and every small scale project.

The second area for discussion is the determination of what will be and what will not be the subject of an environmental assessment. The Ontario Act clearly states that all government projects are subject to the Act unless exempted out, and all private sector projects are excluded unless specifically designated.

1 Presented at the 1978 Assembly of the Environment Councils of Canada

* Chairman, Ontario Environmental Assessment Board

It is the former, the exemption process, which has occupied considerable attention. The Ministry of the Environment established screening criteria (Annex 1) which broadly outlines factors to be considered when determining what projects should be under the Act.

The Ministry of the Environment, through a period of negotiation with each individual Ministry, developed a schedule of projects which would fall under the Act based on the screening criteria. Initially, many projects were exempted because of previous commitments in terms of approvals, design detail, and dollars spent. We are reaching a point where these exemptions are gradually expiring and many environmental assessments are under preparation.

To oversee the implementation of the process in Ontario, the government set up a "steering committee", with Dr. Donald Chant, of our Board, and also of the Canadian Environmental Advisory Council, as Chairman, and the Deputy Minister of the Environment, the Vice-Chairman of the Environmental Assessment Board and myself as members. We meet about once a month to hear update reports from the Ministry of the Environment on the implementation of the Act. The chairman reports directly to the Premier after each meeting. In this way problems and disagreements can be ironed out at Cabinet level quickly and efficiently. A particular concern of the Steering Committee at present is the inclusion of the municipal sector, that is, those projects initiated and carried out by municipalities throughout the province.

The third area includes some selected aspects of the system from the point of view of the proponent. In particular, this will deal with the timing of submissions and the quality of the submissions, both of which to a great degree are controlled by the proponent. The actions taken by a proponent, be it a government ministry, agency, private corporation or individual, can greatly influence the time the process takes. The first thing the proponent must determine is whether it is exempted or not from the provisions of the Act. If it is included, it is desirable that it open a line of communication with the appropriate branch of the Ministry of the Environment as soon as possible. The Ministry will provide both general and specific advice on the content of the environmental assessment document and on the environmental assessment process itself. The view of the Ministry is that the more communication the better.

The proponent should also realize it will not be the Ministry of the Environment only that reviews the environmental assessment document. The Ministry acts as the co-ordinator of a number of government ministries and assembles a total review. Since the Ministry therefore should be able to direct the proponent to the appropriate persons in other ministries who are able to provide detail on the kinds of information to be produced, it is much more likely that effort will not be wasted in putting together a great compendium of unnecessary information. It will also minimize the review time necessary because of the initial correct approach.

This too is an area where contact with the public can be useful. The Ministry has noted that public participation is useful at an early stage to both gather and disseminate information. The Board has found that the public often has a great deal to offer, and if the information can be effectively utilized early, it will likely save time later.

There are some recent developments in the United States of relevance to this subject. The National Environmental Policy Act 1969 was the pioneer of environmental legislation. The Americans have recently been reviewing the effectiveness of the process and the early guidelines. In late 1977, guidelines relating to the implementation of the Act were issued by the Office of the President. Two in particular, Reducing Paperwork and Reducing Delay are relevant. In essence, it appears that while acknowledging the usefulness and effectiveness of the program, efforts are needed to streamline it. More recently (March 1978) the United States Federal Register published an executive order for improving government regulations in general. Again, the thrust was toward administrative reform although here it was not specifically directed to The National Environmental Policy Act. It is of interest that the order included requirements for public participation. Both of these developments are worth bearing in mind as we proceed with the implementation of environmental assessment programs in Canada.

Returning to the Ontario scene and factors to be considered by a proponent, when an environmental assessment document is directed to the Board for a hearing, the proponent should consult with the Board's staff with regard to procedures. The Board attempts to remain as flexible as possible in the hearings as long as all relevant evidence is made available. An understanding of procedures can save time and money by avoiding repetition and debate of procedures during the hearing, and through concentration on issues of greatest concern. It should be the responsibility of the proponent to initiate and continue such contact.

The fourth area is the content of an environmental assessment document. The Ontario Act is very specific both with respect to the definition of environment and the matters which must be considered (Annexes 2 and 3). The definition is very broad and the requirements for the environmental assessment document are quite detailed.

In summary, this paper has highlighted four areas of particular importance at present in the Ontario environmental assessment process. The first of these covered the two types of environmental assessments that may be carried out. The second dealt with the ongoing determination of what is included and what is exempted from the process. The third described some areas which should be given careful consideration by any proponent who falls under the process, and the fourth touched on the specific requirements of the Act in terms of the definition of environment and the content of the document.

Annex 1

SCREENING CRITERIA

ONTARIO ENVIRONMENTAL ASSESSMENT ACT

Might the proposed undertaking:

1. Conflict with the environmental goals, objectives, plans, standards, criteria or guidelines adopted by the province or community where the project is to be located?
2. Have an effect on any unique, rare or endangered species, habitat, or physical feature of the environment?
3. Have effects on an area of ten acres or greater?
4. Have effects on adjacent persons or property or persons or property not associated with the undertaking?
5. Necessitate the irreversible commitment of any significant amount of non-renewable resources?
6. Preempt the use, or potential use, of a significant natural resource for any other purpose?
7. Result in a substantial detrimental effect on air or water quality, or on ambient noise levels for adjoining areas?
8. Cause substantial interference with the movement of any resident or migratory fish or wildlife species?
9. Establish a precedent or involve a new technology either of which is likely to have significant environmental effects now or in the future?
10. Be a pre-condition to the implementation of another undertaking?
11. Generate secondary effects (e.g. land development, population growth) likely to significantly affect the environment?
12. Block views or adversely affect the aesthetic image of the surrounding area?
13. Substantially change the social structure or demographic characteristics of the surrounding neighbourhood or community?
14. Adversely affect human health?
15. Overtax existing community services or facilities (e.g. transportation, water supply, sanitary and storm sewers, solid waste disposal systems, schools, parks, health care facilities)?
16. Be highly controversial?

Annex 2

*1. (c) "Environment" means:

(i) air, land or water,

(ii) plant and animal life, including man,

(iii) the social, economic and cultural conditions that influence the life of man or a community,

(iv) any building, structure, machine or other device or thing made by man,

(v) any solid, liquid gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from the activities of man, or

(vi) any part or combination of the foregoing and the inter-relationships between any two or more of them,

in or of Ontario:

Annex 3

*5. (e) An environmental assessment submitted to the Minister pursuant to Subsection 1 shall consist of:

(a) a description of the purpose of the undertaking;

(b) a description of a statement of the rationale for:

(i) the undertaking,

(ii) the alternative methods of carrying out the undertaking, and

(iii) the alternatives to the undertaking;

(c) a description of:

(i) the environment that will be affected or that might reasonably be expected to be affected, directly or indirectly,

(ii) the effects that will be caused or that might reasonably be expected to be caused to the environment, and

(iii) the actions necessary or that may be reasonably be expected to be necessary to prevent, change, mitigate or remedy the effects upon or the effects that might reasonably be expected upon the environment, by the undertaking, the alternative methods of carrying out the undertaking and the alternatives to the undertaking; and

(d) an evaluation of the advantages and disadvantages to the environment of the undertaking, the alternative methods of carrying out the undertaking and the alternatives to the undertaking.

* The Environmental Assessment Act, 1975

THE EFFECTS OF HYDRO DEVELOPMENT ON RIVERS[1]

R.W. Newbury*

Evaporation from the oceans, precipitation on land masses and streamflow back to the oceans, the hydrologic cycle, is driven by the excess of solar energy received at the equator as compared to the polar regions of the earth. A small portion of the sun's energy can be captured readily by man from the potential energy of the water when it is elevated from the ocean level to the height of the land masses. The potential energy is normally expended as heat from the friction between the flowing water and the land surface as the streams and rivers descend to the ocean. By slowing the flow with a dam in the channel, the frictional losses are decreased in the upstream reach of the river affected by the dam. The potential energy that would have been expended in that reach can now be captured at the dam by releasing the water through a tube to drive a propeller and a generator. The power available is the product of the flow (cu. ft/sec.), and the fall in the reach or, after the dam is built, the drop at the dam (ft.), divided by 11.8×10^3 expressed as megawatts (Mw).

Using this simple formula, the hydro-electric potential of southern Canada was easily identified. By the 1970s, over 265 hydro-electric projects were built to capture energy on 200 rivers and streams. Eighty dams on 53 rivers have a generating capacity in excess of 100 Mw. The largest project, Churchill Falls in Labrador, captures over 5000 Mw at a single site.

Most of the remaining hydro-electric potential in Canada lies in the North. In the last two decades, large multi-dam developments have been started on the rivers of northern Manitoba and Québec. The northern projects differ from those of the South in several important ways:

(1) The projects require massive long distance transmission facilities to move the power from the remote sites to the southern market. To bear the added costs of transmission, the efficiency in generating power is increased by storing and releasing the rivers flow in accordance with the power demand. In addition, the flows are frequently augmented by collecting water from adjacent drainage basins through river diversions.

(2) The projects occur in a sparsely inhabited region of Canada with little competitive resource development. They are all-inclusive and frequently all-exclusive to the traditional fishing and trapping uses of the rivers by native people.

(3) The projects frequently require new and experimental design solutions because of their size, the complexity of combining rivers systems, and the severe climatic conditions under which they must operate. The Nelson River development in northern Manitoba for example, has created the first large impoundment in North America in the widespread permafrost zone.

The environmental implications of altering entire hydrologic regimes in the north have limited counterparts in southern hydro-electric experience. The processes causing readjustment of the rivers must be addressed from first principles. Under natural conditions, the potential energy of the river was expended by the fluvial processess that carve and transport sediment from the myriad of channels that comprise a river system. At any point in the system, the size and form of river channel reflect the quantity of water conducted, the geological materials of the basin, and the length of time that this particular combination of water and land has been in existence. The final form that a river will attain is unknown for the balance between the creation of land masses through crustal movements and the removal of the land surface materials by river erosion occurs over geological epochs that far exceed the record of human observation. In the short span of our society in North America, we have observed only a slow rate of change of river characteristics as they react to residual crustal movements of the ice ages. We must now anticipate and seek to avoid unstable and rapidly changing characteristics as rivers react to the manipulations of man in securing hydro-electric power.

The degree of instability or disruption caused by hydro-electric developments can be related to alterations in the distribution and location of the river's potential energy. The Nelson River project in northern Manitoba is illustrative of a highly disruptive design. In this multiple site development, hydro-electric dams have been built in close proximity on the Lower Nelson River. To augment the power generated at each dam, the Churchill River, which ran parallel to the Nelson 150 km to the north, was diverted into the Nelson in 1976 through 300 km of small tributary valleys (Figure 1).

The diversion was accomplished by raising the level of a main stem lake on the Churchill (Southern Indian) until the water flowed through a new outlet to the south into the Rat and Burntwood river valleys. The distribution of potential energy in the river systems before and after the diversion in summarized in Table 1.

1 Presented at the 1979 Assembly of the Environment Councils of Canada

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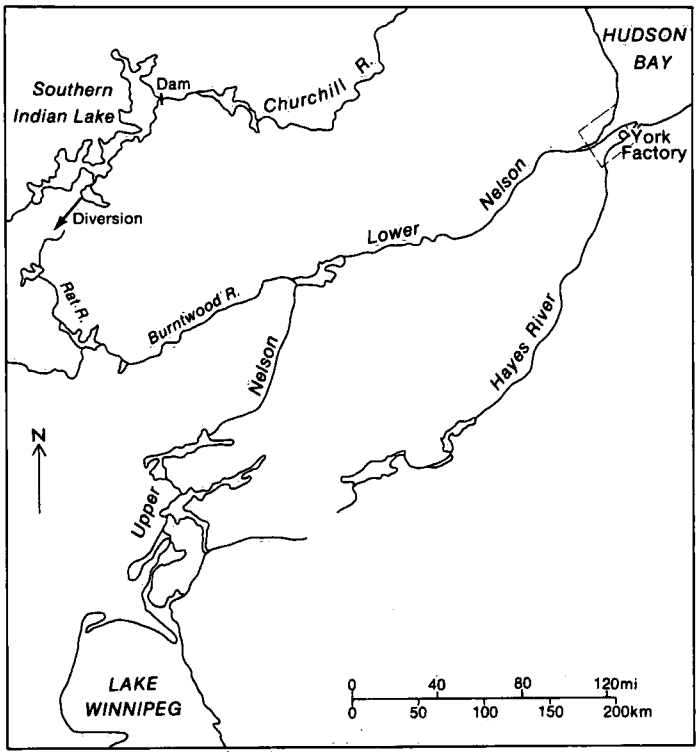

Figure 1 — Churchill-Nelson diversion

Table 1: Changes in the energy distribution of the Churchill and Nelson Rivers following hydro-electric development.

RIVER	ENERGY (Mw)		CHANGE
	Pre-Diversion (age 7000 yrs)	Post-Diversion (age 7001 yrs)	
Rat River	4	153	38x
Burntwood River	45	716	16x
Lower Churchill River	2462	448	2x
Lower Nelson River	natural	natural – 1194	1.3x
Total	2511	2511	
Southern Indian Lake wave erosion		2238	
Total displaced energy	–	4252	
Total additional power generated (1979)	–	423	

For a net gain in power generation of 423 Mw at the Nelson River plants, 4252 Mw of energy were shifted in an environment established following deglaciation of the region 7000 years ago.

In spite of considerable opposition to the diversion component of the Nelson River development, this project alternative was adopted as being the "most economic". In 1976, the waves on Southern Indian Lake began to carve new shorelines in the flooded periphery of the lake and the diverted flows began to form a new Lower Churchill River in the Rat and Burntwood valleys. These are not major changes in the evolution of the river basins since they have been impounded and shifted by glaciation and crustal movements many times in their geological history. In a few centuries, the characteristics of the lakes and rivers will be similar to those discovered 200 years ago during the fur trade era. For a few centuries however, the rate of change and the instability caused by such major, uncontrollable shifts in hydraulic energy will make this environment inhospitable to man.

Historically, the loss of a niche for man in the environment has been the traditional legacy of single-purpose, poorly designed and uncontrollably unstable projects. In the Tigris, Nile and Indus valleys, whole civilizations have collapsed as the clumsily manipulated rivers changed from providers, to uncontrollable consumers of the rare combinations of water and land that are suitable for human existence. River environments inherited by this society in North America are limited in supply and will continue to diminish until hydroelectric and other hydraulic projects are designed to minimize instability and our society has developed a sense of survival in an ancient inherited landscape.

THE PITTSTON PROPOSAL - AN EXERCISE IN COASTAL ZONE MANAGEMENT[1]

D.J. Scarrett*

The Pittston Company proposal to construct a marine terminal and oil refinery at Eastport, Maine has probably occupied the minds and time of more people along this part of the coast than any other single item since the "Passamaquoddy Tidal Proposals" of the late 1950s. It is an extremely good example of why coastal zone management is essential if we are to make optimum use of local natural resources and physical characteristics, and not allow inappropriate, incompatible developments to threaten existing, self-sustaining economies. The only problem with the example is that it has gone on for so long, and so much has been said and written that this paper can barely touch the highlights, let alone explore the details.

The history of the project, in my perspective, begins in about 1967 when we first became aware that a number of land assembly programs were underway in the Passamaquoddy area, all exploiting the fact that adequate water depths for sea-going vessels are available close to shore. One of those programs was that of Metropolitan Petroleum, a wholly owned subsidiary of Pittston, which was interested in constructing a tank farm from which to supply its customers in the northeast. Conventional wisdom has it hat they thus hoped to be able to wrest the contracts for supply of fuel to a local pulp mill from its then current supplier. Be that as it may, in 1968 the company bought an option to purchase the Eastport city airport, 275 acres for the princely sum of 77 thousand dollars. Unfortunately (for the company), the city did not have clear title as the Federal Aviation Administration (FAA) had financed recent improvements to the airfield, and thus retained an interest in its disposition.

Nothing of public note seemed to happen for about three years. In 1971 Metropolitan produced a proposal for using the airfield as the site of a 150,000 barrel a day refinery which would be served by supertanker and product tanker terminals located in the approaches to Cobscook Bay. A public meeting was held in Eastport in September, and another in Augusta in October. Public opinion seemed very divided, but it was very clear that the approval of the Canadian Government, for the use of Head Harbour Passage, would be a crucial issue. Our first formal briefing on the subject was sent to Ottawa in mid November.

The proposal then dropped from public view but resurfaced again in April 1973 under the Pittston Company letterhead in a somewhat larger format. The capacity of the refinery was now to be 250,000 bbl/day and the frequency of tanker traffic was increased. The overall concept remained unaltered. Then began the technical and legal battle that has raged back and forth in a variety of different hearing rooms and court rooms, and which continues to this very day.

The number of people and institutions involved, the reams of paper, and the shelves of documents generated boggle the mind, and all because of a basic incompatibility between an industrial concept and the area chosen for its implementation. It is, surely, the purpose of coastal zone management to ensure that these conflicts do not arise.

Stimulated initially by the closure of the Suez Canal, which effectively limited the dimensions of oil tankers plying between the Middle East and Europe, the last 20 years have seen a major escalation in the size of bulk carriers. This economy of scale has permitted major savings in the unit cost of shipment of crude oil, but has created rather special demands for deepwater ports where vessels can either be lightened before proceeding with reduced load to more conventional ports, or where their whole cargo can be delivered, either to a nearby refinery or to smaller tankers which will complete the journey. The optimum solution is one where terminal and refinery can be close together. Canadian examples are the Irving monobuoy and refinery at Saint John, and the so far unsuccesful Come-by-Chance terminal and refinery in Newfoundland.

With these economies of scale created by the supertanker, we have also seen the enormous escalation in the size of the contamination problem that can accompany the superwreck, and the names of ill-fated ships like *Torrey Canyon, Metula,* and *Amoco-Cadiz* spring readily to mind. None of those accidents took place particularly close to the port of destination, but they, and numerous other incidents, have shown that large tankers can be particularly vulnerable and difficult to handle in confined places and can cause an unbelievable mess. Events such as the *Arrow* and *Kurdistan* have shown that relatively small amounts of oil can cause considerable social disturbance and economic loss among inshore fisheries. The *Kurdistan* spill, for example, caused loss of earnings and damage to fishing gear in excess of one million dollars.

While much of this was still in the future, there was nevertheless a clear appreciation by many people that the construction and subsequent operation of the Eastport terminal and oil refinery could cause severe local problems. Consequently, it is worthwile looking at both the terminal and refinery requirements and the local conditions so that this perception can be understood.

1 Presented at the 1980 Assembly of the Environment Councils of Canada

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Deepwater ports obviously require deep water and, for vessels of 250,000 DWT which is Pittston's 'design tanker', the limiting depth is something like 75 feet. They also require an element of shelter, either to facilitate berthing and cargo transfer operations, or to reduce the periods of bad-weather shutdown. It is also preferable to have land suitable for tank farms and refinery construction as close as possible to reduce on-land pipeline costs. The site should also be fairly close to the market area: a few more miles of ocean travel many not significantly alter crude delivery costs, but may change product delivery routes and costs significantly.

Examination of charts of eastern North America shows that south of the latitude of Portland, Maine, there are no such sheltered locations where deep water runs close to shore with suitable land available. North of that the coastline becomes more deeply indented, and a dozen or more sites offer themselves between there and the Canadian border. There are, however, a series of factors which become progressively more problematical (for the would-be developer) as one moves up the coast and which seem to culminate right in the Eastport/Quoddy Region. The first of these is that Down-East Maine has long been a summer playground for the United States, with a concomitant investment of private and public money in parks and recreation areas and vacation properties. There is thus considerable pressure to divert potentially disruptive industrial developments from those areas where public or private influence may prevail. From the U.S. perspective, Eastport is the end of the line.

At a casual glance, Eastport might appear to offer all that might be desired. The water is deep close to shore, so close in fact that it has been suggested you could moor a supertanker to a tree. This means that jetties and wharves need not be long. The area is well sheltered, there is land available, fresh water, and until last week there was a railroad. To a degree, the community would welcome economic development. But there the favourable factors stop and the second problem emerges.

The root of this problem can be traced back to the time of the retreat of the last ice age which left the Bay of Fundy and Gulf of Maine with their present configuration. Current theory is that the shape and dimensions of this system are responsible for the magnitude of the tides for which the Bay of Fundy is famous. These gradually increase in amplitude from about 1.5 m at Portland, Maine to over 11 m in the Minas Basin 300 miles away. Tidal amplitude at Eastport ranges between 5.5 and 8 m and currents in excess of 6 knots, together with whirlpools and overfalls, are generated on both ebb and flood tides. Something approaching a cubic mile of water enters and exits Passamaquoddy and Cobscook bays on each tide, and it is this potential energy that tidal power advocates have wished to harness for the last 50 years or so.

Bay of Fundy tides do more than generate tricky navigation conditions in Head Harbour Passage, however. The counterclockwise residual current generated in the Bay is responsible for massive upwellings of cold, nutrient-rich water in the area between S.W. Nova Scotia and Grand Manan. The western limit of this water is sometimes referred to as the Fundy Front, and this cold surface water in spring and summer is responsible for the climatic conditions which generate fog. The frequency and duration of summer fog progressively increase from Portland, along the coast until, at Eastport, we reach the foggiest spot on the U.S. eastern seaboard. So our deep, sheltered harbour is shown to have a host of navigational problems which would restrict ships to entering at precise 'windows' on the falling tide so that arrival at the berths would occur at low water slack. Various pilots and navigators have expressed a range of opinions on the navigability of the passage by large tankers. Perhaps the fairest is to say that it is technically possible but not very wise. It is generally conceded, even by the proponents, that accidents and oil spills will happen. These estimates vary from six to eight minor spills a year and one major spill every five years at the worst, to one major spill during the life of the refinery. There would also be the equivalent of two bbl/day lost through chronic effluent discharges. The question from the opponents – or the skeptics – is whether the overall benefits are worth the risk.

Those tidally generated currents which contribute to navigational difficulty and risk are also responsible for the unparalleled natural productivity of the area. The cold, nutrient-rich water upwelling in the mouth of the Bay of Fundy supports a major productive system, the dynamics of which are only now beginning to be understood. Primary oceanic productivity of the classic school does not seem able to account for all of it, so other mechanisms are thought to play a part: productivity from the littoral and sublittoral macrophytes which cover the rocky shores and sublittoral fringe; productivity from mudflat dwelling diatoms and the immense patches of detached, floating seaweeds; secondary productivity from bottom dwelling detritus and suspension feeders; and organic material introduced from rivers and marshlands. All these support the swarms of mysids and euphausids and other planktonic organisms, which in turn support the herring, mackeral porpoise, whales, seabirds, eagles and the extremely well developed local commercial fishery.

In 1978, the small section of coastline within Charlotte County, from Point Lepreau to Grand Manan, an area 40 miles long by barely 20 miles across, produced 60,000 metric tons of herring. By contrast, the landings from Georges Bank, 20,000 square miles in extent, in the same year were only 120,000 m.t., although the sustainable yield from Georges Bank is estimated to be three times that amount. Total Bay of Fundy landings in the same year were in excess of 100,000

m.t. and supported a total work force, in the primary and secondary industries, of about 8,000 persons. The value of fisheries in the primary sector is about $50 million annually of which about half is generated in Charlotte County, within a 25-mile radius of the Eastport site. The value of the secondary industry has been variously estimated at $100 million annually and upwards, depending on the value-added multipliers which may be used.

Proponents of the refinery project argue that the likelihood of serious spills within the high intensity fishing areas is very small and, in any case, the likelihood of wiping out the fish stocks for all time is virtually nil. Technically this may be correct but it overlooks the fact that considerable damage can be done to the local fisheries irrespective of whether any stocks are wiped out or even a year-class depressed.

The principal fisheries of the area are the seine and weir fisheries for herring. Seiners, being mobile, do have the capacity to avoid spills or slicks, but the weirs, being fixed, do not. Weirs function like any conventional trap net, fish being diverted by a leader into a heart-shaped trap from which escape is difficult. The characteristic feature of Bay of Fundy weirs is that they have permanent wooden frameworks to which netting (twine) is fastened for the duration of the season. There are about 250 of them in the area, and they are extremely vulnerable to fouling. Recent experience with entrapped fish subsequently contaminated by spilled oil has shown that tainting can occur (this case is currently before the courts) so there is no doubt that the presence of oil has the ability to affect both the marketability of fish, and the market itself.

Other fisheries, too, are vulnerable. The soft shell clam fishery generates something like a quarter of a million dollars annually and employs about 200 people. Clams, if not directly killed by oil, are extremely susceptible to tainting, and the intertidal zone is the natural recipient of the major fraction of any spilled oil which washes ashore. It is generally conceded that successful containment and cleanup of oil are virtually impossible in the Quoddy region.

The tides have also been exploited in the development of tidal lobster pounds, large storage ponds which exist in a number of coves and inlets throughout the county and which may contain up to five million pounds of lobsters at any one time.

As I suggested earlier, there is an underlying concern for the welfare of the productive system as a whole. It is impossible to predict what would be the effect of entrainment of large quantities of oil into the Passamaquoddy system. Suffice it to say that current evidence shows that the numbers of species, and faunal diversity of the Quoddy area is greater than at any other place in the Bay of Fundy-Gulf of Maine system.

It is also clear that current fisheries management systems in the 200-mile zone seem likely to improve stocks to the point that resurgence of the nearshore groundfish fishery is likely, and the prognosis for these fisheries is good. There is also very recent evidence that these local channels and embayments, with their excellent water exchange and freedom from freezing provide the ideal east coast Canadian location for aquaculture developments. In fact, three farms have already been established in the County at Deer Island, Campobello and Grand Manan. Suggestions that this fishery might in time equal the value of conventional fisheries do not seem unrealistic.

Finally, we must remember coastal zone management is not simply concerned with trade-offs between oil and fisheries. Other existing and potential uses of the area should be considered. The educational and recreational opportunities of the area are only just beginning to be taped.

This is a logical point at which to go back to the history of the project itself and look at how some of these conflicts have been resolved or, rather, not resolved, in the past seven years.

First, it should be remembered that this is an Amercian project by an American company to be located on American soil. It touches Canada in two ways. The first is legal. In order to reach the refinery, the ships are bound to traverse the Canadian waters of Head Harbour Passage. There is no other route, and as we have seen already, there are significant navigational risks and hazards for large, cumbersome vessels negotiating this waterway. The second is moral. The capacity of this project for environmental mischief is considerable, and everything points to the fact that Canada would be the principal recipient of any ill effects, be they from accidental spills or routine liquid or gaseous discharges.

State of Maine law requires that an applicant seeking approval for an industrial development must have, *inter alia*, full title to the site he proposes to develop and guaranteed access to that site. The Board of Environmental Protection (BEP), recognizing the fact of Canadian control of access to the site asked the U.S. State Department to contact the Department of External Affairs. The answer was Diplomatic Note 206 of June 1973 which outlined all the reasons given above and said "No way".

Nevertheless, the company persisted, found a compliant judge who ordered the Board back to work, and the hearings commenced. These went on in various forms for over two years and produced some 30 volumes of testimony from a variety of intervenors both for and against the project.

One of the intervenors was the Province of New Brunswick which had a number of years previously considered and dismissed the possibility of developing deepwater ports in the

Quoddy region. The Province was aided in its intervention by the federal government which produced a special report (later re-issued as Technical Report 428) which detailed all the physical, biological and socio-economic features of the Quoddy region.

The Canadian government later embarked on an exercise to develop a quick method of initial screening of potential deep-water port sites (An Environmental Risk Index for the Siting of Deep Water Ports, Ottawa, 1976). This exercise evaluated the Quoddy region and found it to be the least desirable location of any of the 22 studied on the Canadian east coast.

In spite of the intervention by New Brunswick and other private and official Canadian and U.S. organizations and agencies, the BEP agreed in March 1975 to issue state permits subject to a series of conditions which included restrictions on tanker size and construction as well as the requirement for Canadian approval. Needless to say, several of the parties appealed this decision, and as the time period of some of the permits has expired, their renewal is now being contested. Consequently, the wrangling at the state level still goes on.

Nevertheless, the issuance of the permits cleared the way for the company to apply for its federal permits. By reason of the fact that the Federal Aviation Administration still had an interest in the airfield, the issue was deemed to fall within the purview of National Environmental Protection Agency (NEPA) and the full range of federal agencies was brought into the discussion – this included the Coast Guard, Corps of Engineers, National Oceanographic and Atmospheric Administration (NOAA), Fish and Wildlife Service (F&WS), Department of Energy and the Environmental Protection Agency (EPA). EPA was declared lead agency and set to work to produce an environmental impact statement in October of 1975. The draft Environmental Impact Statement (EIS) was issued a year later. After much criticism, the final EIS was issued in June 1978 with a tentative decision to issue permits. In August 1978, the P.S.D. (Prevention of Significant Deterioration) permit which governed atmospheric emissions was issued, but by then the Endangered Species Act had been passed and on the same day National Marine Fisheries Service requested consultations with EPS on the matter of endangered right and humpback whales which are not uncommon in the Quoddy region. Two weeks later F&WS requested that EPA begin consultation on the matter of northern bald eagles. The last significant population in the eastern U.S. is located around Cobscook Bay. In December of 1978, F&WS determined that the Pittston Project would jeopardize the bald eagle population, and EPA denied the NPDES (National Pollution Discharge Elimination System) permit.

The Pittston Corporation then appealed both the F&WS and EPA decisions, and filed for exemption under the Endangered Species Act. EPA filed for, and was granted, an adjudicatory hearing. There was a lot of extremely complicated legal manoeuvering, but the upshot was that a federal judge was appointed to review the whole process starting with the initial application for federal permits. Last summer Canada was approached by NMFS for recent information on Canadian resources which might be impacted by the Pittston proposal, and this was provided in the form of Technical Report 901 which was produced days before the hearings opened in Boston last January. These hearings ran for nearly five weeks and the judge is now digesting the information. His report is expected this fall at the earliest, but all parties have announced that they will appeal any 'unfavourable' decisions, so the show will go on.

Meanwhile, back in Eastport, the community which was once, almost violently, divided on the issue, now seems to be much more unified in its opposition. Over the years a number of industries and enterprises have moved into the town, and the refinery is no longer seen as the single last remaining opportunity for local prosperity. Last week, the town council voted, unanimously, not to proceed with the sale of the airfield, in spite of the threat of a suit from Pittston. It may even be that Maine law does not allow municipalities to sell public utilities to private developers.

The issue is, however, considerably broader than that. An industrial development with enormous financial potential has the capacity, if poorly sited, to create major problems for renewable resource based industries over a very wide area. It is very clear that Eastport is not a suitable site. Its international implications make it of particular interest to Canada, but if it were a Canadian proposal, would our currently available site screening, or selection mechanisms have enabled us to review the benefits and disadvantages so thoroughly? I would like to think our review processes would have screened the area out on the first pass, as our 1976 East Coast Deep Water Ports Study suggests, but I am not thoroughly reassured of that. There have been some unfortunate errors made in site selection in recent years, and we must profit by those lessons if we are not to repeat the errors of the past.

ANNEX 1

ASSEMBLIES OF THE ENVIRONMENT COUNCILS OF CANADA (1975-1980)

Location, sponsor, and main agenda topics.

1975, Ottawa, Ontario, Canadian Environmental Advisory Council

1) Land Use Planning and Management
2) Public Participation in Government Decision-Making
3) Communication
4) Environmental Education
5) The Urban Environment
6) Environmental Quality Indices
7) Population and its Distribution as an Environmental Problem

1977, Fort San, Saskatchewan, Saskatchewan Environmental Advisory Council

1) Land Use Issues Facing Canadians
2) Nuclear Development and the Environment
3) Environmental Impact Assessment Policy
4) Role of Public Involvement in Environmental Planning and Policy

1978, Brudenell, Prince Edward Island, Prince Edward Island Environmental Advisory Council

1) P.E.I. Institute of Man and Resources on Alternative Renewable Resources
2) Issues and Concerns of Participating Councils with respect to Alternative Renewable Resources
3) An Overview Presentation on Land Use
4) Environmental Impact Assessment
5) Environmental Aspects of Agriculture
6) Toxic Chemicals
7) Public Participation

1979, Hecla Island, Manitoba, Manitoba Environmental Council

1) Federal Strategy with respect to Hazardous Materials
2) The Effects on Health from Hazardous Materials
3) Pesticides in Water
4) Disposal of Hazardous Wastes
5) Legal and Political Implications of the Use of Hazardous Materials
6) Provincial Implementation and Action on the use of Hazardous Materials
7) Economic and Environmental Factors For and Against Hydro-Electric Schemes
8) Overview of Interprovincial Power Grids and Environmental Consequences
9) Effects of Hydro Development on Rivers

1980, St. Andrews, New Brunswick, New Brunswick Environmental Advisory Council

1) Land Use Practices
2) Shore Zone Management
3) Long Range Transport of Air Pollution
4) The Environmental Impact and Implications of the Proposed Pittston Refinery at Easport, Maine.

ENVIRONMENT COUNCILS OF CANADA*

CANADA

Canadian Environmental Advisory Council
Department of Environment
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Ottawa, Ontario
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ALBERTA

Environmental Council of Alberta
8th Floor, Weber Centre
5555 Calgary Trail
Edmonton, Alberta
T6H 5P9

MANITOBA

Manitoba Environmental Council
Box 139
139 Tuxedo Avenue
Winnipeg, Manitoba
R3N 0H6

QUÉBEC

Conseil consultatif de l'environnement
1020, rue St-Augustin
Québec (Québec)
G1R 5J1

NEW BRUNSWICK

Environmental Council of New Brunswick
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1

NOVA SCOTIA

Nova Scotia Environmental Control Council
General Office Centennial Building
1660 Hollis Street
P.O. Box 2107
Halifax, Nova Scotia
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* Active councils as of December 1984

ANNEX 3

MANDATE
CANADIAN ENVIRONMENTAL ADVISORY COUNCIL

The Canadian Environmental Advisory Council was established in 1972 by the decision of the federal Cabinet, to advise the Minister of the Environment on:

- such matters as may specifically be referred to it by the Minister;
- the state of the environment and threats to it;
- the priorities for action by the federal government or by the federal government jointly with the provinces;
- the effectiveness of activities of the Department of the Environment in restoring, preserving or enhancing the quality of the environment.

The Council is composed of up to sixteen members who serve in an individual capacity and are drawn from a wide cross-section of Canadian life and from all across Canada. Officials of the Department of the Environment are not members of the Council; however the Department provides a continuing Secretariat.

To carry out its functions the Council undertakes studies and reviews of matters of environmental concern and policy, holds regular meetings to consider progress and developments with regard to these concerns, and prepares comments, statements and reports as appropriate.

ANNEX 4

DECEMBER 1984

MEMBERSHIP, CANADIAN ENVIRONMENTAL ADVISORY COUNCIL

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LIST OF PUBLICATIONS

Annual Review 1973-1974. Part A – Activities 1973-1974 by Arthur Porter. Part B – Problems and Priorities in the Canadian Environment by Pierre Dansereau.

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