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A COMPARATIVE URBAN FRINGE STUDY METHODOLOGY

BY

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COMPARATIVE URBAN FRINGE

STUDY METHODOLOGY

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ABSTRACT

Concern for problems associated with land use on the rural-urban fringe has had a surprisingly long history in Canada. Recent urban development pressures in this zone have heightened government concern. Most studies have been concerned with describing urban fringe problems and with recommending remedial policies from particular problem perspectives and for particular urban areas.

In an attempt to contribute to a more wholistic and integrated appreciation of the urban fringe this Report presents a design and recommendation for a methodology for explaining the socio-economic implications of land use changes on the urban fringe. The Report consists of two principal parts. One offers a selective survey of past and ongoing fringe research. The other describes a proposed national urban fringe research methodology in which useful definitions, data sourceces, and research tasks are discussed.

RÉSUMÉ

Au Canada, on se préoccupe depuis étonnamment longtemps des problèmes relatifs à l'utilisation des terres à la périphérie des villes; les contraintes dues depuis peu au développement urbain ont accentué l'intérêt du gouvernement. La majorité des études se sont attardées à décrire ces problèmes et à recommander des politiques correctives particulières applicables à des régions urbaines déterminées.

Afin de favoriser une évaluation plus holiste et plus unifiée des limites urbaines, le présent rapport présente un plan et des recommandations de méthodes permettant de comprendre les répercussions socio-économiques des changements apportés à l'utilisation des terres dans les limites urbaines. Le rapport se divise en deux parties principales: la première est un compte rendu sélectif des travaux de recherches passés et présents sur les limites urbaines tandis que l'autre traite d'un projet de méthode nationale de recherches sur les limites urbaines, comprenant définitions, sources de renseignements et travaux de recherches.

ACKNOWLEDGEMENTS

The writer would like to thank the many people who knowingly or unknowingly contributed to this paper. The latter group is duly recognized in the footnotes and bibliography. A special thanks is reserved for those at the University of Waterloo, the Lands Directorate and elsewhere who gave generously of their time to carefully review and comment on the text. Their contributions have been invaluable. A very special thanks is reserved for Dr. Juan F. Scott of the Lands Directorate, Environment Canada who followed this paper from its inception through to its completion. His perceptive observations are reflected throughout.

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INTRODUCTION

Concern for problems associated with land use on the urban fringe has had a surprisingly long history in Canada.[1] This concern has resulted in the production of many descriptive studies focusing on specific problems. Yet it is fair to say that not nearly enough remedial understanding has resulted. Due to the projected development pressures anticipated for the urban fringes of Canadian cities the present shortcomings are cause for concern.

The Lands Directorate, in recognizing this fact, intends to carry out comparative urban fringe studies for Canadian cities as part of a larger study of land use changes in critical areas of Canada. This report has been commissioned to develop a methodology for studying the socio-economic implications of land use changes on these urban fringes.

Statement of Problem

Perceived by some for a long time, the urban fringe "problem" has attracted a much larger audience recently. Despite this awareness there is ample evidence to demonstrate that this "problem", in all its dimensions, persists and enlarges as the urban fringe experiences increased development pressures.

Beginning with the innovative work of the Commission of Conservation during the second decade of this century and followed by the work of numerous government agencies, universities and business firms the urban fringe "problem" has been adequately described for particular urban areas. In an elemental sense the Economic Council of Canada has aptly defined this

problem in terms of urban sprawl "with fingerlike development following transportation routes" and "leap-frogging over large vacant tracts"; an emphasis on single family housing with a resulting decline in gross urban densities; the increasing upward pressures on capital and current costs associated with infrastructural needs; and the "loss of farm land and open space".[2] This list of problems comprising the urban fringe "problem" could be extended with ease.

Our purpose here is not to examine the nature of the urban fringe problem. Rather, it is methodological. Underlying this purpose is the belief that past urban fringe studies have not been sufficient in their design or output to provide the necessary background to public policy formulation. These deficiencies have resulted, in part, from difficulty in defining the urban fringe problem; the lack of a universal conceptualization, and deficiencies of data. These deficiencies will be examined in more detail below.

Objective of Report

In this report we will design and recommend a methodology for explaining the socio-economic implications of land use changes on the urban fringe. To attain this objective, the report is divided into three subsequent parts.

Future urban fringe research by the Lands Directorate should reflect and be responsive to the past and ongoing fringe research of other agencies. Part II surveys other urban fringe research for its potential contribution to the work of the Lands Directorate. Interest

in the urban fringe has been very high in the past few years and the resulting research is voluminous. Therefore this survey does not pretend to be comprehensive.

In Part III a national urban fringe research methodology is described. The urban fringe is defined, delimited, and characterized for the purpose of this study. The methodology is considered from both conceptual and practical perspectives.

The report is summarized and concluded in Part IV.

PART II

A SELECTIVE REVIEW OF URBAN FRINGE RESEARCH AND POLICY MAKING BY GOVERNMENT IN CANADA

Although government-sponsored policy-oriented urban fringe research has expanded most significantly in the past several years it would be wrong to assume that this research has had no legacy. On the assumption that fringe research of the Lands Directorate will be responsive to and reflect both the past and present research of other agencies Part II will review selectively other works of note with the emphasis placed on the potential methodological contributions of these works. It is not the intention of this review to be comprehensive. Rather, it will sample other research that offers specific guidance to the Lands Directorate as it considers its own future role in urban fringe research.

Part II is divided into three sections examining the perspectives of the federal, provincial, and municipal levels of government.

Federal Perspective

In this section we will examine the bench-marks of federal involvement in urban fringe research and policy making. In so doing we will support the validity of the Lands Directorate's current concerns.

The first evidence of the federal government's concern for the urban fringe is revealed in the work of the Commission of Conservation during its existence between 1909 and 1921. Created by an act of Parliament this remarkable body was charged with collecting and analyzing information on Canadian resources "...for the purpose of advising upon all questions of policy that may arise in reference to the actual

administration of resources...[3] Matters concerning rural and urban land were of high priority.

As the work of the commission was winding up its town planning advisor, Thomas Adams, expressed the opinion that:

> Often the worst building development takes place in the rural areas surrounding large cities. The greatest difficulties of obtaining effective control of highways, sanitation and of land development are probably to be found along the fringes just over the boundaries of cities...the selfish interests of the city and of the country mean the neglect of the very territory that most needs planning and the laying down of the soundest conditions of development.[4]

In their entirety, Adams' observations and recommendations - developed during his successful career with the commission - provide a perceptive view of the concerns of one group of federal civil servants toward the urban fringe more than half a century ago. By and large, their concerns are valid today.

The work of the federal Advisory Committee on Reconstruction toward the end of World War II is the second important bench-mark relating federal involvement with urban fringe problems. Created to examine the problems of post-war recovery and to prepare a "blueprint" for future Canadian society, the committee investigated a number of subjects; but none with surer grasp than the subject of housing and community planning. One of the six final reports issued by the committee took special cognizance of urban fringe problems, relating these problems to the lack of comprehensive town planning.[5]

The urban fringe problems identified included:

1. "haphazard fringe dispersion" and "drainage of urban core population",
2. development of road transportation facilities that encourage sprawl and "ribbon development along the main exit-highways",
3. mismatch between demands for public facilities and distribution of tax resources, and
4. "excessive costs of public facilities and services...because of wide residential dispersion..."[6]

The committee recommended a thorough overhaul and development of public planning at all levels of government as the major response to urban fringe and other land use problems. To achieve these ends it was recommended that the federal government become directly involved in the provision of town planning services via a Town and Community Planning Agency; that it contribute to the education of planning personnel and the general public, and that it provide major financial assistance to municipalities for urban reconstruction.

It is ironic that, as an outcome of the committee's work, the National Housing Act came into being. As a result of its liberalization of mortgage credit terms, this act (administered by the Central Mortgage and Housing Corporation) has become a major contributor to low density suburban expansion on the periphery of the larger urban areas of Canada.[7]

While it is fair to state that federal urban fringe research prior to the 1950's contributed very little toward either our methodological or our substantive understanding, this research did establish the precedent for Ottawa's more recent involvement in the urban fringe. Also on the basis

of comparisons between early research and recent research, it would seem that Canadian urban fringes have undergone profound qualitative and quantitative changes during this century. The urban fringe has increased in width, and the socio-economic status of its residents has risen and has become more homogeneous as a result of improved accessibility via the automobile.

In the late 1950s two national bodies considered problems of the urban fringe within their larger concerns for renewable resources and land use in Canada. After a half dozen years of discussion, hearings, and debate the Senate Special Committee on Land Use in very cautious terms concluded that "a research team or teams" be engaged to study and report on "loss of good agricultural lands to urban sprawl..."[8] These long deliberations in themselves might have been considered fatuous given their modest conclusions had it not been for the additional attention focused on land use during the preparation for and events of the Resources for Tomorrow Conference.

Announced by the Prime Minister in 1958 as a national conference on conservation, this conference became a highly successful forum for the discussion of wide ranging problems on renewable resources. The problem of urban fringe land use was given forceful exposure. The major conclusion of the Conference with respect to the urban fringe was that disorderly, low density urban development not only was making the urban fringe extremely expensive to service but also was resulting in the tragic loss of prime agricultural land. It concluded that this problem must be solved through a regional approach to land use planning and decision making.

Papers prepared by Hind-Smith and Crerar for the conference are of methodological interest and so are examined here.[9] In order to express a measure of loss of agricultural land, each researcher employed the land absorption coefficient. This coefficient, measuring change over time, is expressed as acres of agricultural land lost to urban development per 1,000 population increase. It is not to be confused with the static land consumption rate (also used by Hind-Smith) that measures developed acres per 1,000 population. Both measures have been employed in a number of studies since then as methods of quantitatively expressing shifts in land from agricultural to urban use, but they have been criticized as unstable, difficult to interpret and inconclusive. Hind-Smith's land consumption rates did not reveal consistent magnitudes according to city size or over time. Land absorption coefficients are more demanding of data, and do not account for changing urban population densities over time.

Nevertheless, the writer believes that these measures could be very useful in a national comparative study if a set of consistent decision rules were developed to 1) define the study area, 2) distinguish between urban fringe and urban core population changes, and 3) distinguish between agricultural and urban land uses. Gathered nationally, these measures not only would aid in an explanation of urban fringe dynamics but, based on appropriate assumptions of continuity of process, might serve as inputs into a predictive model of urban fringe development.

Hind-Smith attempted to delineate, around four Ontario cities, a zone of agricultural land indirectly affected by urban development. As

defined this zone is analagous to the urban fringe. She identified four indicators of this zone. They are:

1. undeveloped subdivision,
2. non-farm ownership of farmland,
3. farmland for sale for urban uses (indicated by asking price), and
4. non-farm assessment.

As a testimony to the importance of her selection, all of these indicators have been employed frequently in subsequent urban fringe studies.

As a result of the intensive exposure given land use by the Senate Special Committee and the Resources for Tomorrow Conference it could be plausibly argued that urban fringe problems had achieved legitimacy in the eyes of the federal government by the mid 1960s. Since then efforts by several federal ministries have involved the need to develop policies and programs for remedying urban fringe problems.[10] Because of the peculiar constitutional division of responsibilities for land use,the federal role has focused on the encouragement of provincial action through the provision of specialized research and financial inducements.

Provincial Perspective

Efforts by the provinces to come to grips with the problems of the urban fringe are too varied and numerous to treat adequately in this paper. Here, we will limit ourselves to a brief examination of efforts concerned with redressing land use problems on the urban fringe, in three provinces - Ontario, Alberta, and Manitoba. Each province is singled out to illustrate a particular approach that need not be unique

to it. Ontario provides an example of the efforts of a highly urbanized province to consolidate and regionalize local government. British Columbia, and to a lesser degree New Brunswick might also have been examined. Alberta exemplifies the efforts of several provinces (including Quebec and Prince Edward Island) to develop an extremely sound information base for land use planning and decision-making. Manitoba is a unique example of a province, with only one major urban centre, attempting, through governmental reform and improved land use information, to solve the urban fringe problem.

Ontario

It is to be expected that Ontario, the most urbanized (82.4% in 1971) of all provinces, would be deeply involved with the problems of interface between urban and rural Canada. While this assumption is, in fact, true Ontario's commitment is less than a decade old. In 1966 the White Paper, Design for Development, set the stage for a rapid succession of innovations to follow.[11] Although the implications of this White Paper were very broad, extending into many facets of government, the underlying concern was directly related to the persistence of unfavourable patterns of urbanization, resulting in too rapid growth in some urban areas and chronic stagnation in others.

In 1968 a companion document to Design for Development enunciated the province's policy on regional government.[12] This sweeping statement revealed the government's intention to restructure and consolidate local governments in the more populated urban regions so that there would be a greater congruency between urban problems and local government's

responsibility for and ability to solve these problems. The significance of regional government in Ontario cannot yet be fully assessed. However, Ontario's eight urban centred regional municipalities, exercising responsibility for the critical planning, public infrastructure, and finance elements (among others) are now in a position to deal comprehensively with future development on the urban fringe.

It is by no accident that the boundaries of established regional governments in Ontario conform to a rather generous delimitation of the urban fringe - in this instance more accurately called the urban shadow. The concept of regional government is based on the urban centred region notion and is given substance through application of a set of criteria. The urban centred region covers "the major urban centres and the surrounding areas which together share social, economic and physical services."[13] The criteria employed by the province to assist in the delimitation of cities and their urban shadows are:

1. A region should exhibit a sense of community based on sociological characteristics, economics, geography and history;

2. A region should have a balance of interests so that no one group or interest can completely dominate the region;

3. There must be a financial base adequate to carry out regional programs at a satisfactory level;

4. The region should be large enough so that local responsibilities can be performed efficiently by taking advantage of economies of scale;

5. Regional boundaries should facilitate maximum inter-regional cooperation;

6. There must be community participation and, where possible, community acceptability;

7. The new regional government boundaries should be usable by other institutions;

8. If there are to be two tiers of government within a region, both tiers should be designed with the same criteria.[14]

Two salient characteristics of proposed regional government help us to visualize its boundaries. These characteristics relate to size and shape. The size of the region results from the interplay of service and access. In order that services are provided efficiently a minimum regional population of from 150,000 to 200,000 is required. In order that government be responsive and responsible, the size of the region should not be so great that individual citizen access is impaired. The shape of the region will likewise influence service and access characteristics. Implicit in the consideration of shape is the concept of an urban centred region in which the urban centre and the rural hinterland are mutually interdependent.

Perhaps Ontario's criteria for defining urban centred regions lack specificity and are open to wide interpretation. Nevertheless, they remain, even today, the best North American evidence of regional government theory transformed into practice. For that reason, these criteria should be examined when any effort is made to delimit the urban shadow or the urban fringe for Canadian cities.

Ontario has not acted alone in its attempt to spatially rationalize local government.[15] But it did act first and continues to set the pace as the first province to address itself to those urban fringe problems identified nationally long before by the Commission of Conservation and the Advisory Committee on Reconstruction.

More recent activities of the Ontario government fall within the context established by Design for Development. Employing the Toronto urban region for discussion purposes we will briefly mention the Toronto Centred Region and four specific provincial acts regulating land use on the Toronto urban fringe.

In May, 1970 the province released a report on the Toronto Centred Region (TCR), an area centred on Toronto.[16] Representing a more detailed, logical extension of Design for Development, Phase I, this document presented a basic concept for the comprehensive development of an area linked intimately, in socio-economic terms, with Toronto. It would be misleading not to point out that the TCR and its successor, the Central Ontario Lakeshore Urban Community (COLUC) remain yet to be transformed from a stimulating concept to a practical guide for provincial land development investment in the region. Having discovered the political liabilities of explicit structure plans entailing long term commitments it is understandable that the province has moved slowly to implement the TCR concept.

Nevertheless the pressure of urbanization in the TCR has resulted in the creation of four provincial acts that are now being employed to implement the TCR concept. The Niagara Escarpment Act and the Parkway Belt Act are intended to control or exclude urban-type development within areas designated for recreation, open space, and agriculture. The Planning and Development Act permits the province to designate areas in which it intends to carry out comprehensive planning directly. Prime areas are those parts of urban fringes experiencing rapid development pressure but outside the jurisdiction of area-wide local government. The Land Speculation Tax Act, by levying a twenty percent tax (orginally fifty percent),on the vendor's sale

price, is intended to defuse speculative land trading on the urban fringe and to release sufficient raw land that land prices are moderated.[17]

In summary, the Province of Ontario's response to problems of urbanization in general and problems of the urban fringe in particular is contained (at least in theory) in Design for Development and the several pieces of legislation that have specific application to urban fringe land use. In a province that maintains a strong free enterprise orientation, the government has exhibited a willingness to intervene in the land market on the urban fringe.[18] The persistence of fringe land use problems probably is as much an indication of the complexity of the problem confronted as it is a measure of policy effectiveness.

Alberta

Concern for urban fringe problems in Alberta can be traced to 1950 and 1951 when regional planning commissions were established for the Edmonton and Calgary regions. These commissions emerged in response to a need for a coordinated municipal attack on the problems of urban land use resulting from rapid urbanization.[19] Much of their energy has been directed toward regulating and channelling urban development on the urban fringe through the use of their powers to prepare and enforce regional plans and approve subdivision applications. While the work of the regional commissions is important and this experience should be made widely available, it is not examined further here.[20] Instead we will examine the progress of two major provincial studies aimed at appraising urbanization and land use problems in the province.

In 1971 the province and the ten cities formed a task force to examine, over a three year period, the problems of urbanization. Among six task committees created to consider various aspects of urbanization one committee focused upon problems of metropolitan regions facing rapid growth.[21] The committee selected the Calgary region for its detailed attention.

Some of the recommendations of the committee are examined here.[22] Before specific problems could be redressed, the committee insisted that the province must have overall development goals and that the Calgary region must have an overall development strategy. Then, geographic and population limits should be adopted for all communities in the region. Lands peripheral to urban settlements should be acquired for public recreation and large blocks of land between these settlements should be limited to low density uses.

Long-and short-term implementation policies were recommended. These policies included expansion of the existing police, taxation, and proprietary powers of provincial and local governments. Taken together they depicted a broad consensus for more rigorous control of land use changes on the urban fringe.

The use of the task force approach should be of particular interest to readers for it indicates the Alberta government's desire to include a very large measure of public involvement. Instead of a traditional research study conducted in relative isolation from various interest groups, these groups were brought into the process through their representatives who

participated on task committees. Task committees provided the vital link between citizens and representatives of government departments and agencies.

Concern for urbanization and land use in Alberta has resulted in a second very interesting public vehicle for study and policy formulation. Established by Order-in-Council in the fall of 1973 the Alberta Land Use Forum is responsible for investigating and recommending provincial responses to land problems related to farming, recreation, the urban fringe, corporate and foreign ownership of land, population distribution, and ownership rights to land. The forum maintains contact with and receives technical support from the government through a liaison committee consisting of representatives of the departments of Agriculture, Environment, Lands and Forests, Municipal Affairs, Conservation Authority, Housing, and the Task Force on Urbanization.

The forum's work program consists of four phases, 1) technical studies, 2) public participation programs, 3) public hearings, and 4) final report and recommendations. Phase Two is now in progress. Thirty-one technical and summary reports have been published providing both government and citizens of the province with a valuable information base for subsequent phases of the program.[23]

In reflecting upon these recent activities of the Alberta government, what accomplishments of national significance can be identified? More than any other province, Alberta unequivocally has identified land use as a critical problem and has proceeded to develop a sound information base for policy formulation. In addition, the province has cultivated a

process that seeks maximum public involvement from the beginning. In a process that must ultimately recommend that citizens give up certain rights and privileges to land for the long term public interest, this fostering of involvement must be viewed as an adroit move.

Manitoba

The Manitoba experience with municipal administrative and fiscal reform is well known to Canadian students of urban land use problems.[24] This experience will not be examined here. Rather, we shall look at the Winnipeg Region Study - a sophisticated attempt by the provincial government to examine changing land use patterns within a "region" delimited by a 30-60 mile radius about the city of Winnipeg. Our attention will be focused on the study methodology and its relevance for a comparative national study.

While the delimitation of the study area may appear to be arbitrary it is not without some justification. Census and building permit data for 1961 and 1971 indicated that the rate of increase of rural non-farm residents within a 30 mile radius of downtown Winnipeg was greater than the rate of increase of urban residents within this same area. If this trend continued it was estimated that an additional 5,000 to 10,000 rural non-farm residents, occupying an additional 3,000 to 6,000 acres of rural land would be present by 1981.[25] These new residents would be dependent upon Winnipeg for their employment and services. Thirty miles (approximately 45 minutes driving time) was accepted as the maximum commuting range from Winnipeg. We might note that a study area defined by a circle

has the political advantage (as well as some disadvantages) of remaining impartial to jurisdictional boundaries and thus dispelling any local apprehensions of provincially-imposed local government reorganization.

Both commuting distance and the rate of change of rural non-farm residents versus urban residents -- which were used in the Winnipeg Region Study -- have considerable potential as criteria for delimiting the urban fringe for national comparative study. Provincial highway departments continually generate data on traffic flows within metropolitan regions. From time to time, this data is supplemented with more detailed data from origin-destination surveys. The monitoring of the rate of change of rural non-farm residents may be accomplished on a sample basis for large scale areal units mainly by comparing residency and occupation information extracted from annual assessment rolls and perhaps supported by census and building permit data.

The concept of the Winnipeg Region Study originated within the Department of Municipal Affairs, Municipal Planning Branch in the summer of 1971 as a response to a continuing increase in demand for rural residential subdivision. The objective of the study was:

> To develop a set of policies relating primarily to the physical accommodation of development within a 30-60 mile radius of Winnipeg. The policies should satisfy both amenity and development values and at the same time optimize the development pattern within the context of competing land uses, resource base utilization and environmental quality. Moreover, a variety of living possibilities should be provided.[26]

Questions asked in the submission indicate the scope of the study objective:

- What political and administrative arrangements are necessary to effectively plan and implement on a regional basis?

- ...is the province prepared...to give recognition to certain communities as having a dormitory or satellite role to play within the region?

- Should the demand for rural residential development in the region be accommodated...?

- Is it necessary or feasible to preserve land best suited to agriculture?

- Is it necessary or feasible to preserve areas with a relatively high capability to support outdoor recreation?

- What restrictions should apply in areas with severe limitations for septic field operations or in areas where ground water pollution is a risk?

- Is it necessary or feasible to preserve industrial mineral deposits?

- Should river bank property in the region be preserved for public recreation?[27]

Figure 1 depicts the elements of the study in flow chart form. The elements consist of two groups; those necessary for determining the demand for rural residential development and those depicting the constraints on alternative land uses. Together, demand and constraints provide the basis for determining the spatial form of future land conversion in the Winnipeg region.

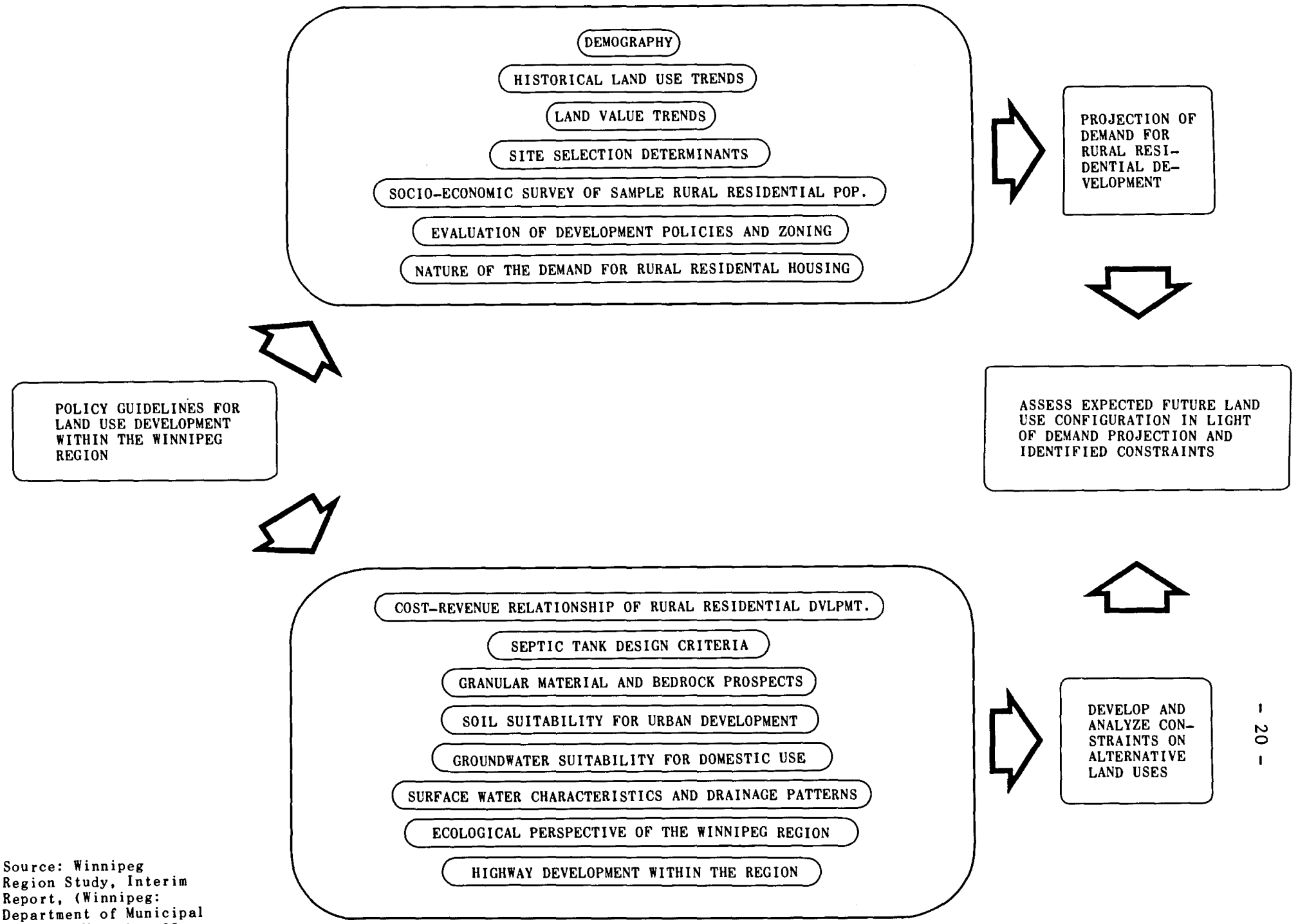
Several elements of the study should be of particular interest because they may provide new understanding of urban fringe phenomena. An appreciation of land market dynamics is essential to the adequate understanding of the fringe yet detailed information on land value trends is usually lacking. The land value trends component of the Winnipeg Region Study will help to answer some important questions. Due to weaknesses in its methodology the answers to other questions will remain suspect.

The socio-economic characteristics of urban fringe residents - including income, education, occupation and attitudes toward their environment - are poorly understood by public policy makers. Thus it is difficult to determine demand for exurban living. The Winnipeg Region Study has examined these elements and, as a result, is able to offer some initial insights into present and future demand for land.[28]

An attempt to offer a complete evaluation of the Winnipeg Region Study is not realistic in the context of this report. The study is still in progress and documentation is not yet complete. Other aspects of the

STUDY PROGRAM FLOW CHART

Figure 1



Source: Winnipeg Region Study, Interim Report, (Winnipeg: Department of Municipal Affairs, November 26, 1973), p. 9.

WINNIPEG REGION STUDY

study involving funding, distribution of costs, data sources, and research design for specific elements of the study have not been examined here. Nor have criticisms of the methodology been leveled. Nevertheless this ambitious and thoughtful study does provide insight into the delimitation of the urban fringe and the identification of its problems and data requirements.

Municipal Perspective

All Canadian metropolitan areas experiencing urban growth problems have instituted some form of planning and research mechanism to deal with these problems. As might be expected, the nature of this mechanism varies from area to area according to the perceived importance of problems, the area's history, its socio-economic structure, and the physical environment, just to mention a few background factors. Although the urban fringe problem is present in each of these metropolitan areas, the variety of background factors makes it difficult to isolate the efforts of one or several metropolitan areas and to suggest that these efforts are representative of the larger group. On the other hand,an attempt to examine all or most of the recent metropolitan experiences is clearly beyond the scope of this report.

Here we will briefly review a few metropolitan planning and research efforts to deal with urban fringe problems. These programs are deliberately selected to provide a range of experiences for a variety of urban fringe conditions.

It is argued here that our present level of understanding does not enable us to easily differentiate urban fringes across Canada according

to their perceived importance of problems, their history or their socio-economic structure. For this reason it is suggested for now that we differentiate urban fringes according to physical determinants alone and that we review planning programs that represent the range of urban fringe types.[29] The following four urban fringe types are suggested:

1. rough terrain, serious environmental constraints, expensive servicing, problems with infilling;

2. absolute limits to the expansion of the urban fringe (at least in terms of present economic and technological choices available), threat to finite resources in short supply, eg. agricultural land;

3. free standing or isolated urban region enabling expansion in any direction and restricted only by efficiency considerations;

4. urban region within a coalescing megalopolitan system, relatively easy expansion of the fringe at present but constraints in the future, good agricultural land.

1. There are many Canadian urban regions in which urban fringe expansion is limited by rough terrain and serious environmental constraints. On these fringes servicing is expensive and already scattered development is almost impossible to consolidate due to problems of infilling.[30] St. John's, Halifax, Saint John, and Sudbury are examples. To some degree the Chicoutimi-Jonquière and Quebec metropolitan areas share in these difficulties.

The work of the Halifax-Dartmouth Metropolitan Area Planning Committee (MAPC) is representative of the efforts of many of these municipalities to deal with urban fringe problems. In their Technical Summary they recommend that urban sprawl be contained within a development boundary and that development controls be adopted along Halifax County roads.[31] The provision of trunk sewer and water services are to reinforce desired land use

patterns. Beyond the built city infilling is to be permitted in designated villages and hamlets. Ribbon development will not be permitted. If the recommendation to consolidate the cities of Halifax and Dartmouth together with Halifax County as a single tiered local government is followed, the prospects for achieving the development objectives of the MAPC will be more favourable.[32]

2. Urban expansion in some regions is severely limited by natural physical constraints. Water, steep slopes and even climate may conspire to make increased development unfeasible by present economic and technological standards. Often finite local resources are threatened as well. The Vancouver and Victoria metropolitan areas, hemmed in by mountains and the sea and in direct competition with agriculture for the limited, level terrain, best fit this description but numerous other smaller urban areas - particularly on the margin of the Canadian ecumene - conform to this description. Ocean Falls, B.C., Churchill, Manitoba, and Goose Bay, Labrador are appropriate examples.

The urban fringe problems of the Greater Vancouver Region have gained national prominence as a result of the recent action of the provincial government in forming the B.C. Land Commission and in freezing land conversion on the scarce, prime agricultural lands in the lower Fraser Valley.[33] But this prominence does not originate with the Land Commission Act. It can be traced to the innovative work of the Lower Mainland Regional Planning Board. Over a period of eleven years the Board produced for the Vancouver urban fringe a series of analyses that

remain classics today.[34] It is a pity that neither the warnings nor the evidence moved governments to action in those earlier years.

We can benefit from a brief examination of the methodology and analysis that support the findings of the board's research. In each of the studies referenced below the phenomenon of concern was urban sprawl, the distribution of discontinuous but urban oriented non-farm residences on the periphery of urban areas. The terms urban "fringe" or "frontier" were employed interchangeably to identify the area covered by sprawl. Time, distance, and density measures were used to quantitatively delimit the area.

In Dynamics of Residential Land Settlement, the ratio of urban (developed) to rural (vacant) land was calculated against 5 minute automobile travel (time-distance) zones centred on downtown Vancouver. Values plotted on double log graph paper displayed a linear relationship, suggesting the suitability of parametric statistical analysis and prediction. The form of the curve was instructive. Initially steep within the city its slope became shallower with distance from the city until it assumed an almost horizontal shape at a distance of 55 to 60 minutes driving time from downtown Vancouver. At this point the ratio of developed land to vacant land within the whole zone was approximately equal to 1. A residential land value curve was also plotted by travel zone and compared with the developed-vacant curve. The observed positive relationships apparent in the two curves should suggest to the reader the possibility of substituting land value data with land use data, for the purpose of defining the outer limit of the urban fringe.[35]

In another study, Economic Aspects of Urban Sprawl, the board attempted to measure the municipal costs and revenues associated with sprawl on the urban fringe. It is interesting for our purposes that this study unintentionally produced a quantitative parameter for delimiting the urban fringe. On a gross settlement density scale ranging from 0.03 to 10 people per acre one settlement pattern segment was discovered to consistently pay less in municipal taxes than it received in services. This segment, ranging from 0.3 to 3.5 people per acre, was determined to be the zone of sprawl on the urban fringe.

The Urban Frontier, Part I and Land for Living describe the urban fringe as containing extensive but sporadic city-sized lots 60-62 feet wide by 120-132 feet deep. This 100 square mile area is less than 20 percent developed yet in 1963 could accommodate the areas of Vancouver, Burnaby and New Westminster combined. The report, Economic Aspects, adds that the fringe also contains areas that are exclusively devoted to scattered properties from 1 to 10 acres in size.

Before one contemplates employing these measures for delimiting urban fringes in a national comparative study some caution is advised. First, the findings of the board were based on the examination of one urban fringe and therefore lack wider testing for accuracy and reliability. Second, the occupancy/time-distance and the cost/revenue measures required fairly elaborate data files that might prove to be too expensive to collect nationally. Nevertheless the findings of the board are instructive and stimulating.

3. A number of Canada's larger, rapid growing urban regions are isolated and free-standing; able to expand in any direction and restricted only by the efficiency constraints associated with declining residential densities. Calgary, Regina, Saskatoon, Edmonton, London, Ottawa-Hull, Montreal, and Winnipeg are examples of this third type of urban region. The concern of public officials is undeniably reflected in a Calgary report:

> The outward spread of the City of Calgary in the past decade has accelerated at a considerable rate. This rapid development has been complicated by the varied and sometimes conflicting social, economic, physical and environmental aspirations of people and has greatly increased the complexity and multiplicity of problems with which the City must cope.[36]

In these urban areas, trends toward declining suburban densities and increased population growth rates on the fringe foretell of increasing rates of land absorption, costly roadway systems and either costly or deficient utilities and public services.

4. The fourth type of urban region is located within a coalescing megalopolitan system. Because of historical factors these urban regions are usually located on good agricultural land and physical constraints to expansion are minimal. But, at some point in time, large aggregate demand for land within the megalopolis and declining relative supply result in excessively expensive cost. This great demand for land as an economic good poses a threat to agriculture, open space and environment. Most of these urban regions are located in the Toronto and Montreal megalopolises.

The Kitchener-Waterloo urban region is an interesting example of this fourth type because it illustrates the phenomenon of metropolitan dominance at several levels and provides vivid examples of both urban fringe problems and attempted solutions. At the same time that Kitchener-Waterloo has been gaining dominance over neighbouring urban centres, during a period of rapid post World War II growth, the larger urban region has shifted into a zone of Toronto domination. There is no better evidence of this trend than changes in the Kitchener-Waterloo housing market. Land and construction costs have responded directly to similar costs in Toronto. As Toronto's housing market has expanded price differences have been reduced. Continued price differences and the growing acceptance of longer commuting trips to the Toronto job market ensure that this trend toward megalopolis will continue.

Ontario's response to urbanization has been described already. The creation of the Regional Municipality of Waterloo to include Kitchener, Waterloo and the surrounding urban and rural municipalities is a tangible example of this response. Because the province has demonstrated a commitment to regional government as a major policy response to problems of urbanization, it is worthwhile to briefly comment on Waterloo's efforts to prepare an official regional plan.

An examination of a draft of the Official Plan reveals a decided conservation and anti-growth bias.[37] The population growth rate is to be reduced and people will be encouraged to live at higher densities. Four features of the land are identified for conservation. These include

agricultural resources, sand and gravel resources, flood plains, and environmentally sensitive areas. Policies for settlement pattern, housing, open space and recreation, transportation, and utilities are intended to support and conform to conservation and growth policies.

In the belief that recommendations for a national urban fringe study methodology should not be prepared without recognizing past and present research and policy concerns of government, the writer has carried out a highly selective review of federal, provincial, and municipal involvement in the urban fringe. With this as background, the substance of an urban fringe methodology is examined in Part III.

PART III

COMPARATIVE URBAN FRINGE STUDY METHODOLOGY

The urban fringe is an abstraction of reality. There are no generally accepted boundaries delimiting urban fringes for Canadian cities. Nor is there a commonly agreed upon list of problems that comprise the urban fringe "problem". At present, there is no theory of the urban fringe; no national framework in which empirically derived data can be rearranged to provide generalized understanding. Comprehensive, consistent data describing urban fringe phenomena over space and time are inadequate. Until the present no public or private agency has sought or assumed the responsibility for correcting these omissions. As such the fringe remains an enigma open to a variety of often conflicting interpretations and more often than not, unresponsive to remedial public policy.

But the presence of confusion in defining the problem and the location, and the inconsistency of remedial action does not reduce the importance of the fringe as a critical area of concern on the agenda of Canadian land use problems. As the receiving area for a large proportion of future urban development the fringe, in its present state of disarray, is even more urgently a valid subject for study, particularly at a scale that can bring greater national understanding of and agreement on these problems and their solutions. Because the urban fringe is, unquestionably, one of the most critical land space zones in Canada the need for, and justification of, a national urban fringe study should be self-evident.

This concurrence of a perceived (albeit amorphous) problem and a particular land space zone presents some difficulty for research design.

Research provides a means toward specified ends. Methodology and techniques - the specific working elements of research - are designed to achieve these research ends efficiently and reliably. However, our difficulty in defining urban fringe problems and delimiting the urban fringe in a national context places limits on our methodological efforts. Perhaps because of this situation,the Lands Directorate has defined its own research objectives regarding the fringe in an exploratory context, expressing no specific objectives related to theories or hypotheses testing.

As a result the writer treats each section of Part III in two ways. First, the subject matter is conceptualized in broad terms that will accommodate a variety of possible research interests held by the Lands Directorate. This approach is idealistic in that it does not assume constraints on resources or interests. Reference is made here to methodology and techniques that hold promise for urban fringe research. In the second approach,the writer expresses a more limited, personal view of what should be done assuming constraints. Hopefully, these two approaches will enable the contracting agency to weigh the consultant's recommendations against other possible research approaches.

Part III is divided into six sections. In order to arrive at a clearer appreciation of the urban fringe the first section explores the nature of the urban fringe "problem" and suggests ways in which our conception is shaped by our perception of "problem". In the second section we take a statistical overview of recent population levels and changes

for Canadian urban areas. This is conducted in an effort to better appreciate the Canadian urban fringe realm. In the third section we review definitions of the term "urban fringe" and methods for delimiting the fringe. Here we recommend a working definition and a technique for delimiting the defined fringe. The fourth and fifth sections examine the more specialized needs of a national comparative urban fringe study. These include data needs and methods of data collection. The sixth section reviews the research methodology as a sequence of tasks.

Defining Urban Fringe Problems

Our conception of the urban fringe is very much shaped by the manner in which we perceive urban fringe problems. The literature may discuss these problems in shopping list form, with no indication of the relative importance of each problem and no attempt to unravel inherent contradictions.[38] Often, because of bias or narrow interest some researchers have presented a limited, partial view of urban fringe problems.[39]

The effort by Russwurm to develop a systematic typology of urban fringe problems and to indicate the relative intensity of these problems from the perspective of several interest groups is a particularly useful contribution.[40] Eight categories of empirically derived problems are presented.[41] They are:

1. haphazard, scattered, and conflicting land use activities,
2. services and taxation,
3. governmental, planning, and administrative difficulties,
4. land speculation, land fragmentation, and high land value,

5. environmental impact,
6. impact on agricultural land and activities,
7. social problems, and
8. impact on surrounding settlements.

Suggested research accompanies each of the eight categories of problems. A review of these problem categories will indicate their arbitrary nature. For problems that are so interrelated categorization is, at best, tentative. The more complex the categorization becomes, the less general will be its applicability.

Perhaps it would assist in reducing the complexity of urban fringe problems if researchers were able to discriminate more precisely among problems, their symptoms, and causes. The observations of Lithwick on urban problems are quite relevant to the urban fringe.[42] Clearly, there are problems <u>on</u> the urban fringe and problems <u>of</u> the urban fringe; here we distinguish between problems that happen to occur on the urban fringe and those that are an integral part of the process that creates and maintains an urban fringe. Many of the most visible urban fringe problems are of the former type.

For example, structural changes in urban fringe agriculture probably are less related to the proximity of the city than to important economic and technological changes influencing the industry on a national and international scale. Land speculation and high cost land on the urban fringe is another example of problems that are symptomatic of more fundamental problems not limited to the fringe. To treat these problems <u>on</u>

the fringe as if they were unique problems of the fringe and to attempt the direct solution of these problems in piecemeal fashion may be futile and may serve only to aggravate them.[43]

In actuality,the urban fringe is a very complex, dynamic subsystem of the larger urban system. Its problems result from the highly variegated interdependencies among phenomena of the urban system interacting with non-urban phenomena on the fringe. Because problems on the fringe have often been treated in isolation without an adequate understanding of their extent, impact and cause, policy responses have had limited success and have often produced undesirable side-effects.

What type of urban fringe problem classification might take into consideration this highly interdependent, dynamic urban systems context? The answer to this question is not readily available and therefore is justification for important urban fringe research.

One approach to an urban fringe problem classification might embody some elements of the theory of ecological succession as developed in the field of biology.[44] Ecological succession is the "orderly and progressive replacement of one community by another until a relatively stable community occupies an area."[45] Succession implies the replacement of components of one type of plant and animal community by the invading components of another more complex community. Urban settlement may be viewed as the climax stage of human succession where equilibrium between man and his environment is achieved. The urban fringe is an outcome of the functional and social segregation of persons and property based on socio-political, economic, and physical determinants.

Within the fringe there are two groups of people: invaders and residents. Invaders consist of families seeking sites for homes, businessmen seeking sites for firms and governments seeking sites for public services. Residents include farmers and an indigenous population servicing the farm community. Conditions for conflict are readily apparent and are likely directly proportional to the rate of urban expansion.

It is important to recognize these two groups and the sub-groups comprising their membership in order to appreciate the difficulty in defining the urban fringe. Each group and sub-group perceive the urban fringe problem in a particular and conflicting way. Because the locus of their concern is usually identified on the basis of one or several related problems having their own unique spatial dimensions the fringe remains an imprecise, if not fuzzy, abstraction interposed between the margins of the built city and the genuinely rural countryside.

In Table 1 problems within the urban fringe component of the urban system are classified under type of succession and population group experiencing the problem. Problems are further distinguished according to their socio-political, economic, and physical characteristics. A few representative problems are indicated within Table 1 for illustrative pruposes. As an elaboration on the problem of government control on the urban fringe, as perceived by invaders and residents, consider the frequent conflict between two groups on township council. One group consists of recently arrived non-farm residents (invaders) who would like to impose stricter controls on the loss of agricultural land, while another group consists of lifelong

Table 1

Problems in the Urban Fringe Component of the Urban System

Population Group	Primary Succession (on urban fringe)		
	Socio-Political Problems	Economic Problems	Physical Problems
Invading Population	- unresponsive local govt. - insufficient govt. control	- inferior services	- environmental destruction
Resident Population	- challenged value system - too much govt. control	- high property taxes - crop pilfering	- loss of amenities

local farmers (residents) who would like to sell their land quickly to urban developers in preparation for early retirement.

Although the resident/invader typology assists us in conceptualizing the concerns of two important population groups on the urban fringe, we should recognize that some individuals, in reality, will defy neat dichotomization. For example, the young part-time farmer who moves to an inherited family farm on the fringe, while maintaining a job in the city, may be regarded as a resident or an invader at the same time by different individuals. However this problem is not of sufficient importance to weaken the potential value of the typology.

It will be important to fill out, as completely as possible, the boxes in Table 1 so that problems identified are truly representative of the national perspective. Deeper understanding of these problems will only develop as the national comparative study proceeds.

If elaborated upon, this type of classification system should reveal the interdependencies of urban fringe problems. Many problems commonly associated with the urban fringe might better be treated as problems within the larger urban system or problems of the national economic system. By distinguishing between an invading population (consisting of urban households, firms and institutions) and a resident population (consisting of farms and farm service operations), attention is focused on the relationship between specific problems and those who perceive them most accurately. Finally, utilization of the concept of ecological succession (despite its theoretical shortcomings when applied as human ecology) gives full recognition to the dynamic nature of the urban fringe.

The Canadian Urban Fringe Realm

Presumably, all permanent, nucleated, non-farm settlements in Canada, regardless of size, have a distinguishable urban fringe. This includes the small hamlet of less than one hundred residents to the largest metropolis. However, it is reasonable to assume that the fringe varies qualitatively as well as quantitatively according to size of settlement. It might also vary according to other characteristics of the urban area including its economic base, political organization, site, situation, history, and cultural setting. In fact, identified by dozens of physical, social and economic variables, it should be possible to create any number of urban area/urban fringe profiles from which samples could be drawn for useful study.

In 1971 there were 2,120 incorporated cities, towns and villages in Canada. Thousands of unincorporated urban settlements could be added to that total. It becomes clear that an attempt to study the fringes for a universe of Canadian urban settlements would be an unnecessary strain on limited resources and the added insights of questionable worth. A sample of urban areas might be drawn to satisfy many different sets of criteria. The writer believes that absolute population size, percentage increase, and population density are important criteria for identifying this sample. This will be particularly true if government's interest in the urban fringe remains closely identified with the concept of the fringe as a critical area facing formidable problems associated with change.

If urban fringe problems are concentrated in urban areas exhibiting the characteristics of large population, rapid population growth, and high overall population density, then our attention should be focused on the larger Canadian metropolitan regions. Table 2 contrasts total urban population change for large urban regions (100,000 population or more) with total population change for small urban regions (less than 100,000 population), total urban population,

Table 2

Urban Population Change
By Large and Small
Urban Regions
1966 - 1971

	1966	1971	% Change
Urban Regions of 100,000 Population or more	9,469,304	10,246,165	+ 8.2
Urban Regions of less than 100,000 Population	5,257,455	6,164,615	+17.3
Urban Regions Total Population	14,726,759	16,410,785	+11.4
Rural Region Dwellers	5,288,121	5,157,525	- 2.5
Canada Total Population	20,014,880	21,568,310	+ 7.8
Urban Regions 100,000 Population or more as % Total Urban Pop.	64.3	62.4	
Urban Regions 100,000 Pop. or more as % Total Pop. Canada	35.7	37.6	
Urban Regions Total Populations as % Total Pop. Canada	73.6	76.1	

Source: Developed from Statistics Canada, Census of Population, Urban and Rural Population (AP-4), 1971, Table 2.

and total population, for the five year period, 1966-1971.[46] When one compares the percentage change of urban population for large and small urban regions it is evident that the small urban regions are growing at twice the rate of the large urban regions. However, in absolute terms, the population of large urban regions has maintained an almost constant proportion (37%) of total Canadian population and it continues to support 2 of every 3 Canadians living in urban regions. Since the rural region dwellers are the only component of total population which declined in the same period, the growth of small urban regions between 1966 and 1971 has thus been at the expense of rural areas.

It is reasonable to assume that an unknown but significant population, classified as being resident in rural areas or in small urban regions, is actually located in close proximity to large urban regions and is socially and economically integrated with the latter regions.

Employing general land density coefficients and the population data for Table 2 it is possible to develop crude estimates of land consumption for urban development occurring between 1966 and 1971.[47] For urban regions of 100,000 population or more there was an increase of 776,861 people on 64,738 acres. For urban regions of less than 100,000 population there was an increase of 907,160 people on 90,716 acres. Employing the above acreages one can estimate that urbanization pressure in Canada between 1966 and 1971 resulted in the conversion of 155,454 acres (243 square miles) of non-urban land to urban uses. This crude analysis fails to provide an adequate appreciation of complex inter-regional population flows that contribute to the lengthening shadow of large urban region dominance.[48]

Although the large urban regions have experienced most of the urban growth in the last few years, this growth, by no means, has been distributed either equally or proportionally among them. Table 3 depicts population changes between 1966 and 1971 for the twenty-two Census Metropolitan Areas

Table 3

Population Increase
1966 - 1971
Census Metropolitan Areas

Census Metropolitan Areas	Population (in 1,000's) 1966*	1971	Absolute Change 1966-1971	Percent Increase
Calgary	330.6	403.3	72.7	22.0
Chicoutimi-Jonq.	133.0	133.7	0.7	0.6
Edmonton	425.4	495.7	70.3	16.5
Halifax	209.9	222.6	12.7	6.1
Hamilton	457.4	498.5	41.1	9.0
Kitchener	192.3	226.8	34.6	18.1
London	253.7	286.0	32.3	12.7
Montreal	2,571.0	2,743.2	172.2	6.7
Ottawa-Hull	528.8	602.5	73.7	13.9
Quebec	436.9	480.5	43.6	10.0
Regina	132.4	140.7	8.3	6.3
Saint John	104.2	106.7	2.5	2.5
St. Catharines	285.5	303.4	18.0	6.3
St. John's	117.5	131.8	14.3	12.2
Saskatoon	115.9	126.4	10.5	9.1
Sudbury	136.7	155.4	18.7	13.7
Thunder Bay	108.4	112.1	3.7	3.4
Toronto	2,289.9	2,628.0	338.1	14.8
Vancouver	933.1	1,082.4	149.3	16.0
Victoria	175.3	195.8	20.5	11.7
Windsor	238.3	258.6	20.3	8.5
Winnipeg	508.8	540.3	31.5	6.2
All CMA's	10,685.0	11,874.4	1,189.4	11.1

* Based on 1971 CMA boundaries

Source: Canada Year Book, 1974,

(C.M.A.'s) of Canada.[49] Urban growth is concentrated in the metropolitan areas of a few provinces. Of the 11 CMA's with the largest percentage increase 5 are in Ontario, 2 each in Alberta and British Columbia, 1 each in Newfoundland and Quebec.[50] Seven of the 11 slowest growing CMA's are located in Quebec, the Maritimes, and Saskatchewan. Three times as many people (868,100) were added to the 11 fastest growing CMA's as were added to the 11 slowest growing CMA's between 1966 and 1971.

It is important not to ignore absolute size of CMA when associating growth with urban fringe problems. The three largest CMA's - Montreal, Toronto, and Vancouver - with low to modest percentage increase of population (6.7 percent to 16.0 percent)-still accounted for 55.5 percent (660,000) of the total population increase of all CMA's. With very large population bases these three CMA's will continue to contribute significantly to future urban growth even if their percentage increase should decline somewhat.

In this section we have suggested that a non-random judgemental sample of urban fringes should be drawn for study. Criteria for drawing this sample should be directly related to absolute size, percentage change, and perhaps density of urban region population. We have not suggested how many urban fringes should comprise the sample. While a suggestion will be made in the last section of Part III,this decision very much depends upon the resources of the funding agency. However, something more should be said here about the representativeness of the sample. If the above strategy was pursued exclusively,it might produce deficiencies

in the study. It will be noted that the less urbanized and slower growing provinces are not highly represented among CMA's. From a logical viewpoint this is reasonable. Yet in a political system where the provinces exercise much of the authority for shaping and controlling urbanization it would seem practical that the final sample of urban regions contain at least one urban region from each province.

Defining and Delimiting the Urban Fringe

It is suggested that the definition and delimitation of the urban fringe be treated together in this section because, in practice, each is the complement of the other. The fringe is defined largely by its delimiting parameters. In fact the term "fringe" cannot be employed in discussion independently of its qualifying parameters without misunderstanding resulting. On the other hand,the parameters employed for delimiting the fringe are a pot-pourri of descriptors drawn from various unrelated studies. Taken together they cannot be related, with any certainty, to a broadly based theory of urban fringe.

Definitions of Urban Fringe

In his classic article, Wehrwein defined the urban fringe "as the area of transition between well recognized urban land uses and the area devoted to agriculture."[51] He pointed out that the definition was not hard and fast because of the overlap of the economic and sociological city with the rural way of life. The fringe was much smaller than either the city's trade area or its commuting area and could best be located

in terms of land uses or modifications of land uses than in any other way.

After completing a study of the urban fringe in which he reviewed some sixty case studies of fringe areas, Pryor offered the following definition:[52]

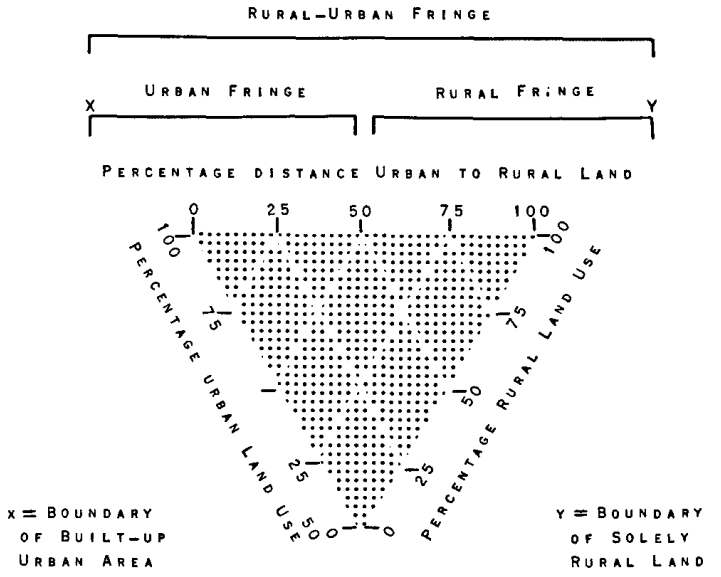
> The rural-urban fringe is the zone of transition in land use, social and demographic characteristics, lying between (a) the continuously built-up urban and suburban areas of the central city, and (b) the rural hinterland, characterized by the almost complete absence of non-farm dwellings, occupations and land use...

In his review he identified a number of structural components (location, administration, population density, zoning regulations, dwelling age) and functional components (land use, employment, population density, utility services, social orientation, "traditional dynamism") that contributed to the various definitions employed. However he was compelled to acknowledge that no definition of the fringe yet developed had "successfully integrated these various components of the fringe with (1) theories of urban invasion, and (2) practical delineation techniques."[53]

To assist in the formulation of an improved definition and in the integration of urban fringe components he proposed the following schematic diagram (Figure 2). He asserted that it combined the concept of urban invasion with the heterogeneous land uses found on the fringe. It also suggested a means of quantitatively delimiting the "rural-urban" fringe into its rural and urban components.

Figure 2

Schematic Diagram of Land Use
in the Rural-Urban Fringe



Source: Pryor, "Defining the Rural-Urban Fringe",

In his review of urban fringe studies Pryor identified a large number of parameters (both operative and inoperative) that might be employed to define and ultimately delimit the urban fringe. In Table 4 we have summarized these parameters under the three general headings of socio-economic, accessibility, and land use characteristics and have attempted to indicate their possible relationship to the urban and rural areas.

Russwurm has attempted to lend some substance to the urban fringe concept.[54] He has described the fringe as a zone of rural countryside extending beyond the continuous suburbs and under active competition from urban land uses and activities. More than fifty percent of the

Table 4

Summary of Urban Fringe Parameters
Identified by Pryor

	Comparison of Urban Fringe Parameters with same parameters in	
Socio-economic	urban area	rural area
age distribution	younger	younger
sex ratio	higher	lower
fertility ratio	higher	lower
married residents	higher	higher
size of households	larger	smaller
foreign born	smaller proportion	greater proportion
commercial and skilled workers	greater proportion	greater proportion
income	higher	higher
education	lower	higher
length of residence	shorter	shorter
community participation	lower	lower
Accessibility		
utility service network (water, sewage, gas, paved roads, fire hydrants)	incomplete	less incomplete
auto ownership	higher proportion	higher proportion
location of place of work	same	in city
accessibility of schools	poor	—
location of patronized retail stores	same	in city
Land Use		
proportion of farm workers	—	smaller
proportion of part time farmers	—	larger
size of farm	—	smaller
intensive agricultural production	—	more
land values and taxes	lower	higher
residential lot size	greater	—
dwelling size	smaller	—
mean value of dwelling	smaller	—
home ownership	greater	—
house rents	lower	higher

Source: Developed from Pryor, "Defining the Rural-Urban Fringe."
(——) not available or not applicable.

population in the fringe consists of non-farm people. In the largest Canadian metropolitan areas the fringe can have a width of more than ten miles. For smaller cities,the fringe may be five miles wide or less and contains a population density of fifty or more persons per square mile.

While these efforts to quantitatively define the urban fringe have been very useful, the results remain incomplete. They are derived from a very few empirical observations and they need to be tested for a variety of cities differing in size and geographic location across Canada. There is additional need to precisely define terms such as "rural" and "non-farm population" for different urban regions across Canada. Finally, it is clear that simple concepts of resident population and population density are insufficient to adequately define the complex concept of "urban fringe". Income, leisure time, life style, and other factors may influence the urban fringe quite independently of population changes.

Fundamental to an understanding of the urban fringe is its dynamic and transitional nature. When the population of an urban place increases it is usually accompanied by expansion of the built-up area at its outer margin. At the same time additional rural countryside comes under strong urban influence. Over time the urban fringe is displaced outward. Because of its dynamism, the complex nature of urban fringe land use is not well captured by cross-sectional studies. These static approaches need to be complemented by longitudinal studies that monitor changes into the future as well as record past changes.

In essence there is no single, precise definition of the urban fringe that can satisfy the variety of mental constructs revealed in the literature. Writers agree that the urban fringe is a highly dynamic, transitional zone encircling urban areas and that it shares a set of socio-economic, accessibility, and land use characteristics that may be employed in its delimitation. However these characteristics tend to be continuous rather than discontinuous and the fringe zone tends to grade subtly into rural countryside rather than reveal sharp edges. Furthermore, in the absence of comparative urban fringe studies, individual case studies have emphasized particular rather than general comparative phenomena. Therefore it remains difficult to synthesize the findings of these studies.

We will examine below methods for delimiting the urban fringe before we propose a final definition.

Delimiting the Urban Fringe

How might we delimit the urban fringe? This could be accomplished employing either deductive or inductive methods. Employing deduction we would conceptualize the urban fringe in terms of structure and processes. Variables describing the urban fringe would be identified and if necessary practical, readily available surrogate variables would be substituted for those variables less amenable to precise quantification and interpretation. Supplied with a theoretical construct and operational measures a researcher could then delimit an urban fringe. His initial success would be determined by the degree of conformance between the characteristics of the

identified urban fringe and the mental construct. But more fundamental success would be determined by the degree to which this mental construct proved useful in explaining structure and process and in leading to superior public policy. Any evaluation of success must be related closely to the researcher's objectives. If his objectives are achieved then the method is justified.

Most urban fringe research has employed a weak deductive approach to delimiting the urban fringe for single urban regions. Case studies have been conducted to achieve limited objectives. Much of the academic literature has been descriptive and of limited explanatory value. Many studies referenced by Pryor and Russwurm have sought to describe the urban fringe on the basis of simple theory and in terms of single (or very few) variables.[55] The use of these variables as parameters for delimiting the urban fringe may have been adequate for the limited objectives at hand. However the fringe delimited in such an arbitrary manner is not necessarily adequate for broader purposes, whether those purposes be to explain land use dynamics on that particular urban fringe or to delimit urban fringes for national comparative purposes.

An example should clarify this point. Employment of a quantitative urban-rural land use/travel time parameter by the Lower Mainland Regional Planning Board to delimit urban sprawl or the use, by the Ontario government, of a list of qualitative social, economic and political criteria for delimiting the boundaries of regional government were both adequate for their purposes. But they would not necessarily be adequate

for defining a multiple purpose urban fringe for one urban area or for defining urban fringes for national comparative purposes.

It is also possible to delimit the urban fringe employing inductive methods. We could assume that we do not possess the necessary understanding required to conceptually define the urban fringe or to single out those variables deemed to be most important for describing the fringe. Of course, we must still admit to some *a priori* assumptions including the areal units examined (eg. townships, enumeration areas, etc.) and the variables that we assume to be possibly relevant.

At this point we might apply analytical techniques that are capable of spatially discriminating a distinctive zone lying between urban centres and their rural hinterlands. A simple technique might involve an overlay analysis of various urban fringe phenomena plotted on maps. Analysis would seek to pinpoint discontinuities or gradations in the intensity of phenomena that suggest appropriate fringe boundaries.

Two mathematical procedures - principal components analysis and factor analysis - have been employed extensively for grouping and classification and are potentially useful for identifying the urban fringe.[56] The analysis consists of a mathematical procedure for creating new independent variables (orthogonalization) from original variables containing intercorrelations. These new independent variables or factors are then interpreted for possible empirical significance.

A brief examination of one application of factor analysis for the delimitation of the Kitchener-Waterloo urban fringe is of interest.[57]

The study area consisted of 122 blocks averaging seven square miles each and together encompassing Kitchener-Waterloo's urban fringe and a generous outer perimeter of rural countryside. Observations were collected on 58 variables including population, land use, land ownership, assessment, and distance. The factor analysis reduced the 58 variables to 7 factors that statistically "explained" 68 percent of the variation in the variables for the 122 blocks.

Factor 1, named the urban fringe factor because of the contained variables, consisted of 17 variables and explained almost 32 percent of the variation. Especially high values for the factor loadings were noted for non-farm population and the number of non-farm and residential parcels. The mapping of factor scores for factor 1 on the 122 block base map produced a crude cartographic depiction of the urban fringe.

It is appropriate to caution the reader at this point. The data requirements of principal components analysis and factor analysis are considerable. Russwurm derived 46 of his 58 variables as a result of a time-consuming search of township assessment rolls. The final urban fringe maps were strongly influenced by several important subjective decisions including, the original selection of variables, the choice of areal units, and the interpretation of factors and factor scores.

The last technique reviewed here for inductively defining the urban fringe involves the development of a system of algorithms for computerized terrain classification from air photos or digitized earth satellite information. For a more complete discussion of the technique

the reader should consult the footnoted sources.[58] A very brief overview of the technique and its potential application to urban fringe research is provided here.

An ordinary air photo reveals a great complexity of detailed information to the skilled interpreter. Unfortunately the human eye is incapable of identifying and evaluating much of the information revealed in the subtle variations of grey tone over the surface of the film. It is possible to replace the human eye with extremely sensitive photoelectric equipment that can accurately and consistently measure and compare these variations. If a positive transparency is placed in the front focal plane of a lens and is illuminated by a beam of coherent light (laser) the diffraction pattern produced along the back focal plane represents a two dimensional Fourier transformation of the transparency. This diffraction pattern is a unique representation or spatial signature of the variation in light energy transmitted by the photograph and thus indirectly measures the variation of light energy received from the earth's surface and gathered by an imaging device (eg. camera or optical scanner). .

It would be possible to prepare a library of Fourier transformations, each one the spatial signature of a distinctive land use/terrain pattern found in the urban region. If urban fringe parameters were supplied, a computer could be programmed to 1) identify spatial signatures representative of the urban fringe and 2) match each areal unit in the urban region against the urban fringe spatial signatures in order to delimit the fringe.

It is possible to disassemble or generalize a spatial signature. Cultural features (roads, field patterns, houses) can be very easily distinguished from natural features (hills, water, woods) because they occupy a distinctive position on the spatial spectrum. Natural features can be filtered out while cultural features can be examined in more detail. The distinctive characteristics of a range of spatial signatures on the urban fringe might be summarized into fewer, more general spatial signatures. Perhaps these generalized signatures could be used for comparative purposes on a number of urban fringes.

Automated terrain classification for delimiting the urban fringe is possible. A number of universities possess the necessary equipment.[59] Because urban regions are fairly compact, high altitude air photos with their superior resolution could be used in place of satellite imagery. Although the advantages of this technique are evident, certain disadvantages also exist. Due to the newness of the technique, not many Canadians are familiar with its possibilities. Application of the technique to a national comparative study would require additional time for development and testing, yet the implied risks of new applications would remain.

Conclusion

Earlier discussion in this section has pointed to our limited ability to define and delimit precisely the urban fringe. Existing definitions are general or even vague. Delimiting parameters are either very specific to a particular study and thus may be held suspect when universally applied, or they do not suggest decision rules for

locating significant discontinuities in data arrayed on a continuum from urban to rural. Methods for delimiting the urban fringe have been as arbitrary as the single or few parameters selected to measure quantitatively the variation of phenomena in the urban region. Several less subjective techniques have been identified. They have considerable potential but their data requirements and time constraints should be weighed carefully against agency resources.

The consultant recommends that the urban fringe be defined and delimited simply and arbitrarily. Russwurm's definition is appropriate.[60] The urban fringe should be viewed as a zone of rural countryside extending beyond the continuous suburbs and under active competition from urban land uses and activities. More than fifty percent of the population on the fringe should consist of non-farm people. For the large Canadian metropolitan areas with populations in excess of 100,000 the fringe should have a width of more than ten miles.

It is essential that the fringe be overbounded for study purposes. Non-fringe rural areas should be included with the urban fringe in order that contrast is preserved. Without this rural contrast one is left with a fringe study area that conforms only with its initial definition and as a result, study findings would still not provide a more precise determination of the fringe's outer boundary. Overbounding would also allow for expansion of the fringe over time and longitudinal research while still preserving the necessary fringe/rural contrast. For these reasons the urban fringe outer study area boundary should be as much as 15 miles

beyond the edge of the built city for large metropolitan areas under 1 million population (eg. Ottawa-Hull, Quebec, and Winnipeg) and 20 miles for metropolitan areas over 1 million population (Toronto, Montreal and Vancouver).

The Data Matrix

To those who have done research on an urban fringe, the problems associated with obtaining adequate data are only too well known. To those who have attempted to conduct comparative urban fringe research the data problem has been exceedingly severe.[61] In the report on his massive comparative study of metropolitan expansion in the United States, Clawson was moved to complain that:

> ...suburban land conversion is a field notably lacking in solid data of clear meaning. Time and again, anyone who deals with this subject must use data that are considerably less than perfect.[62]

Deficiencies in urban fringe data are the result of two factors; the fairly recent recognition of the urban fringe as a critical area and an inadequate conceptualization of the fringe for consistent, comparative research. The result has been that government-generated data adequate to the need and studies with comparative potential have not been forthcoming. These difficulties have been augmented for the growing urban regions by a dynamism that outpaces efforts to collect and process the data necessary to understand urban fringe processes.

Lacking a strong theoretical foundation and guided by objectives that have been vague and even contradictory, fringe research has frequently been weakened as a result of too much emphasis on "needed" data

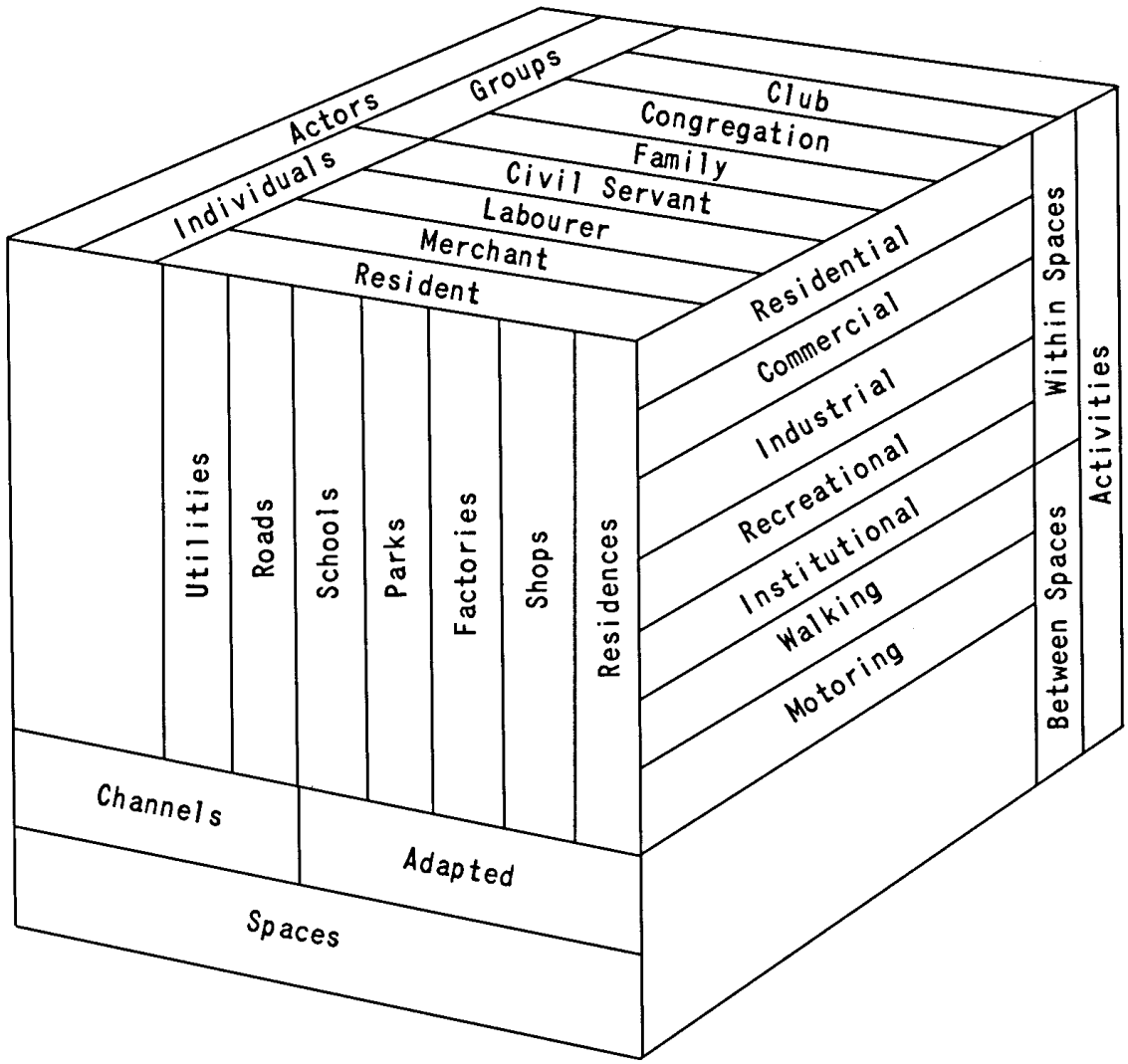
identification and collection. The land use-transportation studies carried out by many metropolitan planning agencies in North America during the 1960's are an example of this weakness. These studies, dependent on large volumes of data, have exhibited insatiable appetites that have encroached upon resources originally allocated to other purposes. The writer believes that data needs must be identified conservatively if the requirements for comparative research are to be balanced against available resources.

Figure 3 provides a conceptual view of data requirements for the urban fringe in which three data matrices for spaces, actors, and activities intersect on planes within a cube. This illustration is meant only to be suggestive: Because of the limitations of the graphics it neither reveals the full number of data sets nor the precise nature of the interaction among sets. For example, the illustration is intended to suggest that a resident living in a residence creates a residential activity. When that resident visits a shop or commercial space, a commercial activity results. If data for each space, actor and activity on the urban fringe could be recorded and synthesized over time it would then be possible to compare similarities and differences in structure and process on a national basis for a sample of fringes. Of course, a research effort of such a magnitude is totally unrealistic.

The researcher must make two important decisions regarding this hypothetical data matrix. For how many of the boxes within the matrix will he collect data? Will data matrices be prepared for more than one time period - if yes, how many?

Figure 3

Conceptual View
of the
Data Matrix



For the national study, the data matrix should be simplified by reducing in number and complexity the elements of the data sets. Land use, a derived data set resulting from the interaction of actors, activities and spaces, is the most critical information to be developed. Land tenure, another derived data set, is equally basic to any fundamental urban fringe research. A third, derived data set, land tenure purpose, would be extremely useful but is difficult to obtain. "Purpose" is the essence of human activity on the urban fringe linking present and future behaviour and decision making. Obviously, it is most often determined by inference through the examination of surrogates. It is not clear that the direct solicitation of "purpose" would produce information more credible than information now generated indirectly.

Presented in Table 5 is a list of data types that we consider to be relatively easily obtained and useful for a national comparative study. (We are assuming that a sample of urban regions will be drawn and that spatial sampling within the urban fringe will occur.) While not all data types listed here need to be collected, a necessary and minimal data set should include representative data types from each of the nine sub-categories. Table 5 also provides reference to data sources and to urban fringe use precedents in Canada. Emphasis is on standard data files obtainable from national sources and, in a few, important instances, on special custom data generated on a sample basis (eg. air photo interpretation and ground surveys). The listing of Canadian use precedents is not intended to be comprehensive. Primarily, it attempts

Table 5

Recommended Data Types, Sources and Use Precedents for a National Comparative Study of the Urban Fringe

Data Types	Data Sources	Canadian Use Precedence
Information For Spaces		
Natural Resources Characteristics - natural cover, hydrography, soils geology, environmental carrying capacity.	Environment Canada -CFS-CWS-CLI Energy, Mines and Resources	D. Coleman,* Ont. Ministry of Natural Resources* Halifax-Dartmouth Regional Study
Land uses - quality, quantity, intensity and value of land uses and dwelling units, land consumption rates, land absorption coefficients.	CLI, National Air Photo Library, CMHC, Statistics Canada, Provincial Highway Depts. Planning Agencies & Assessment Records	L. Martin, J. Punter, Winnipeg Region Study (WRS) Lower Mainland Regional Planning Bd. (LMRPB), Hind-Smith, Crerar, G. Gad
Land Tenure - description by location and type		L. Martin, L. Russwurn, Hind-Smith
institutional controls (zoning, severance policy, planning, ...)	Provincial Registry Offices and Fed. Dept. Public Works Provincial Planning Depts.	J. Punter, A. Coleman,* Hind-Smith, LMRPB
Information For Actors		
Social - age distribution, sex ratio, size of household, foreign born, education, length of residence	Statistics Canada Small Sample Surveys	WRS, LMRPB, Alberta Land Use Forum (ALUF), Ontario Regional Govt. Studies (ORGS)
Economic - income, occupation, auto ownership, cost-revenue data for urban expansion	Statistics Canada, Prov. Depts. of Economics, Small Sample Surveys	L. Russwurm, ORGS, Advisory Committee on Reconstruction, LMRPB, WRS
Demographic - absolute size, percentage change and density of population for urban and rural areas of urban region, urban-rural population ratios by minor civil divisions, intra-urban region migration.	Statistics Canada	Advisory Committee on Reconstruction, WRS, L. Russwurm

Table 5 (cont.)

Data Types	Data Sources	Canadian Use Precedence
Information for Activities		
Land Transactions - grantor, grantee, residence, occupation, acreage, financial terms, legal description	Prov. Land Registry Offices, Fed. Dept. Public Works Small Sample Surveys	L. Martin, ALUF, J. Punter, M. Ferguson* W. Found and C.D. Morley *
House Construction - building permits, housing starts Vetran's Land Act activity, utilities and services activity, NHA activity related to urban sprawl	CMHC, Vetrans Administration, Prov. Depts. of Housing, Utilities Companies	ALUF, WRS, LMRPB, Calgary Planning Dept., Regional Municipality of Waterloo, P. Spurr*
Accessibility Measures - time-distance gradients, commuter sheds, desire line maps for journeys to work, shop, and school	Prov. Depts. of Highways	LMRPB, WRS, ORGS, L. Russwurm

* These sources are not reviewed in the report. Their full bibliographic reference is found in the Appendix.

to relate the recommendations back to material reviewed and evaluated earlier in the report. A few new references of special merit, not reviewed in the report, are also listed and their full bibliographic reference is provided in the Appendix.

The decision to collect land use information assumes the need for a classification. A great deal has been written about land use classifications and many examples exist of classifications extending over the urban fringe. Rather than pursue these the writer recommends that the study employ a classification similar to the one developed by him for his work on the urban fringe. (See Table 6). It has three important advantages. It is developed with the character of the urban fringe specifically in mind; it has been tested successfully on the Toronto urban fringe; and it makes modest demands upon the availability and comparability of data.

Nothing has been said regarding data sources. Urban fringe studies examined by the writer have drawn their data from an extremely wide variety of sources including:

1. government and private standard data files (census, Canada Land Inventory, Canada Geographic Information System, Provincial Assessment Rolls, etc.)
2. special custom data generated or collated expressly for the urban fringe study (air phot interpretation, field observations, questionnaires, etc.)

Both classes of source have a valid place in a national urban fringe study. But specific sources must be judged on the basis of their national comparability and their cost of collection and processing. For these reasons

Table 6

Land Use Classification

Urban Land Uses

(.) - small scattered residences on lots of less than ½ acre or with less than 100 feet of frontage.

(+) - large scattered residences on lots between ½ and 5 acres or with frontage 100 feet or more

(Rl) - low density built up residential land containing individual lots of at least ½ acre or 100 feet of frontage or more.

(Rm) - medium and high density built up residential land containing individual lots of less than ½ acre or 100 feet of frontage.

(I) - industrial, warehouse, and fuel storage.

(E) - extractive including quarries and gravel pits. Usually includes all area within the fence line. Older smaller quarries in disuse often are classified as "U" or "S".

(D) - associated urban uses. Transportation, communications, utilities, schools, churches, auto wreckers, etc. Rights-of-way for transportation and communications, not indicated.

(O) - outdoor recreation. Private and public parks, golf courses, etc.

Agricultural Land Uses

(A) - cropland and cultivated pasture.

(K) - rough pasture and grazing land.

(F) - feeding operations. horse stables, fur and poultry farms, kennels, fish hatcheries.

(G) - orchards and vineyards. If not maintained (i.e. 25% or more open) land is classed as (K) or (U).

(H) - horticulture. Small fruits and vegetables in small fields. Nurseries that grow their own stock on premises.

Other Land Uses

(T) - woodland. At least 75% canopy cover. Includes any reforestation and associated buildings.

(U) - scrub woodland. Less than 75% canopy cover. Includes rough land, steep slope, stream valleys not pastured or used for recreation.

(Z) - water.

(S) - sand.

Source: L. R. G. Martin, Land Use Dynamics on the Toronto Urban Fringe. Report submitted to the Lands Directorate, Environment Canada, June, 1974, p. 59.

federal data files will be superior to data files from other sources and custom data will be generated very sparingly. It is expected that the bulk of custom data will be related to land use and will be derived from a combination of ground surveys and air photo interpretation.

Assessment data has been used frequently to complement land use surveys on the urban fringe. Our experience in the Land Use Dynamics Study indicates that the extraction and coding of land use data from assessment rolls is extremely time consuming and that the end result is highly susceptible to error.[63] However, others (notably Russwurm) have reviewed this data source with more favour, particularly when data applications have been highly localized. In addition the inter-provincial comparability of land use information derived from provincial assessment rolls is suspect. The use of assessment data is recommended only as a limited supplement to land use data from other sources (eg. air photos) and only when it can be confirmed through ground surveys.

Throughout, the writer emphasized the dynamic nature of the urban fringe. Cross-sectional or static studies do not capture this fundamental characteristic of the fringe. Yet a decision to conduct a longitudinal study probably increases the cost of any study exponentially. The Land Use Dynamics Study demonstrated that the examination of earlier time periods constrains considerably methods of data collection.[64] For example, sample field checks, a standard method for corroborating data extracted from contemporary air photos and published data files, cannot be applied to historical data sources. Nevertheless it is the writer's opinion that an understanding of urban fringe dynamics is essential to the identification of fringe problems and to the achievement of a "...long range monitoring program of land use changes..."[65]

For that reason it would be advisable to build a longitudinal dimension into the national comparative study - even at the expense of sample size.

Data Collection

In the two previous sections we provided a working definition of the urban fringe, suggested its dimensions and identified data needs. In this section,we will discuss the collection of data related to two sources - standard data files and custom data. We will recommend that judgemental sampling be employed to select urban regions and urban fringe segments within the urban regions sample.

Because a national comparative urban fringe study will be heavily dependent on standard data files - particularly those of Statistics Canada[66] - it will be very helpful if each urban fringe selected for study lies entirely within a major census statistical unit. For some urban regions a recommended urban fringe of 10 to 20 miles in width is probably truncated by CMA or Census Agglomeration (CA) boundaries.[67] It is also noted that CMA's and CA's are subject to frequent modification. For these reasons it would seem that a larger and more stable census areal unit is required.

After considering various possibilities the writer concludes that a major census unit of data collection - the Census Division (CD) - is most appropriate. For the provinces of Prince Edward Island, Nova Scotia, New Brunswick, Quebec and Ontario, counties serve as CD's. In the other provinces, where there is no administrative equivalent of the county,

special divisions have been created. CD's are composed of Census Subdivisions which may be local incorporated and unincorporated municipalities. The presence of Census Subdivisions within CD's provides the latter with a potential for much finer grain of spatial analysis.

A rich variety of social, economic and demographic data from the census can be analyzed at the CD level in order to cast light on the urban fringe. An example of demographic analysis, Table 7 exhibits the urban and rural components of population change for the twenty-two major urban regions. Each region is composed of one or more CD's: many smaller regions consist of single CD's while the largest urban region, Montreal, consists of eleven CD's. All CD's containing part of a particular CMA are aggregated to form the urban region. In most instances it can be assumed that the urban region, as defined here, consists of a built-up urban core encircled by the urban fringe and the more distant rural countryside.

If population by CMA in Table 3 is compared with urban population by urban region in Table 7 a close correspondence will be observed in absolute terms for 1966 and 1971 and in terms of percentage increase between these years. This indicates that the CD's represent the total urban region as well as do the CMA's. Where this correspondence does not hold (for example, St. Catharines) it is possible that forces are acting within an urban fringe that extends beyond the boundaries of the CMA.

Table 7

Urban and Rural Components of Population Change
1966 - 1971
By Census Divisions
Comprising Urban Regions

Population (in thousands)

Urban Regions	1966 Total	1966 Urban	1966 Rural Total	1966 Rural Non-Farm	1966 Rural Farm	1971 Total	1971 Urban	1971 Rural Total	1971 Rural Non-Farm	1971 Rural Farm	% Change Urban	% Change Non-Farm	% Change Farm
Calgary	369.1	337.4	31.7	13.7	18.1	447.1	414.6	32.5	15.7	16.8	22.9	14.6	-7.2
Chicoutimi	161.8	128.9	32.9	22.6	10.3	163.4	128.2	35.2	29.5	5.7	-0.5	30.5	-44.7
Edmonton	476.2	-	-	-	-	552.5	494.2	58.3	28.9	29.4	-	-	-
Halifax	224.9	195.3	49.6	47.9	1.7	261.5	205.2	56.3	55.0	1.3	5.1	14.8	23.5
Hamilton	383.2	-	-	-	-	401.9	360.3	41.6	34.4	7.2	-	-	-
Kitchener	216.7	186.9	29.8	18.4	11.4	254.0	222.8	31.3	22.0	9.3	19.2	19.6	-18.4
London [a]	249.4	209.3	40.1	20.8	19.3	282.0	240.3	41.7	26.0	15.7	14.8	25.0	-18.7
Montreal [a]	2,597.3	2,521.1	76.2	47.4	28.7	2,752.1	2,674.2	77.9	57.5	20.4	6.1	21.3	-28.9
Ottawa-Hull	592.0	-	-	-	-	669.4	-	-	-	-	-	-	-
Quebec	513.9	456.5	57.4	40.8	16.5	557.9	502.7	55.2	44.9	10.3	10.1	10.1	-37.6
Regina	170.8	134.6	36.2	17.6	18.6	175.2	142.9	32.3	16.7	15.6	6.2	-5.1	-16.1
Saint John	121.5	89.3	32.2	26.7	5.5	125.4	102.8	22.7	19.5	3.2	15.1	-27.0	-41.8
St. Catharines	324.9	267.1	57.9	37.9	20.0	347.3	334.9	12.5	7.7	4.7	25.4	-79.7	-76.5
St. John's	198.3	-	-	-	-	214.4	136.1	78.3	75.8	2.5	-	-	-
Saskatoon	145.1	119.9	25.2	11.4	13.9	153.7	132.2	21.5	10.1	11.4	10.4	-11.4	-18.0
Sudbury	174.5	-	-	-	-	198.1	146.1	52.0	49.9	2.1	-	-	-
Thunder Bay	143.7	116.0	27.7	24.8	3.0	145.4	126.2	19.2	17.7	1.6	8.8	-28.6	-46.7
Toronto [a]	2,513.1	-	-	-	-	2,898.2	-	-	-	-	-	-	-
Vancouver	966.8	-	-	-	-	1,126.5	1,002.3	124.2	104.0	20.2	-	-	-
Victoria	182.2	-	-	-	-	204.8	172.9	31.9	29.5	2.4	-	-	-
Windsor	280.9	-	-	-	-	306.4	246.6	59.8	44.7	15.1	-	-	-
Winnipeg	508.8	500.3	8.5	6.7	1.8	540.3	529.4	10.9	10.2	0.7	5.8	52.2	-61.1
Canada	20,014.9	14,726.8	5,288.1	3,374.4	1,913.7	21,568.3	16,410.8	5,157.5	3,737.7	1,419.8	11.4	10.8	-25.8

[a] Data for one or more Census Divisions comprising urban region not available.
Data not available (-)

Source: Developed from Statistics Canada, Census of Population, Urban and Rural Population (AP-4), 1971, Table 3.

Figure 5

Employing the CD as a coarse spatial unit it is possible to identify major structural dimensions of changes taking place in a loosely defined urban fringe. A comparison of percentage changes in urban, rural non-farm, and farm populations raises many questions for future research. Why are some urban regions experiencing relatively large increases of rural non-farm population yet relatively small increases in urban population (see Chicoutimi, Montreal, and Winnipeg)? Why are some urban regions with relatively large increases in urban population experiencing relatively modest decreases in farm population (see Kitchener, London, and Calgary)? The answers to these and other related questions require more analysis than can be developed from Table 6. But census data at the CD level is capable of raising these questions and suggesting fruitful lines of research.

If the CD establishes the spatial frame for analysis the most important unit of data analysis is the Census Subdivision consisting of incorporated municipalities such as cities, towns, and villages, and unincorporated municipalities known variously as townships, rural communities, parishes, district municipalities and so forth. For finer grain analysis much census information can be obtained for census tracts and enumeration areas. However census tracts and enumeration areas change their boundaries over time impeding longitudinal analysis.

The sources and collection methods for spaces, actors, and activities data derived from standard data files of the federal government are generally well known to those involved in land use and land resources research. Because of its potential importance we will look specifically at the use

of spatial sampling and air photo interpretation for generating custom data.

It is the experience of this writer that air photo interpretation, (supported by other source materials such as maps and special studies), offers the most comprehensive and flexible tool for analyzing land use patterns and land use changes on the urban fringe.[68] Regard for efficiency and need would suggest that air photo interpretation should be attempted for sample areas only on the fringe. Most urban regions do not exhibit growth on their entire perimeters. In fact some segments of the fringe lie relatively dormant while other corridors absorb the major pressures of regional growth. All segments of the fringe hold interest for the researcher. But the critical areas approach suggests that this research should focus on these growth corridors.

While there is very little research on which to test this hypothesis, it is asserted that the socio-economic characteristics of residents of the fringe are very similar across Canada while the physical characteristics of the urban fringe environment are likely to vary quite markedly.[69] If true, the implications of this statement for comparative research, are extremely important. For urban fringe corridors experiencing similar rates of urban development, fringe problems may be more related to physical rather than socio-economic determinants. However for urban regions or urban fringes exhibiting markedly dissimilar absolute populations, percentage changes in population or population density, this assertion and its implications are not necessarily valid.

Therefore it is important, when a sample of urban regions is drawn and when area samples on the fringes of these regions are drawn, that these samples reflect a variety of physical environments.

In Part II we employed a four part terrain-environmental constraint classification for sampling the urban fringe research carried out by Canadian municipalities. The use of this elementary classification reflected our concern for the relationship between terrain-environmental constraints and a need for implementation of resource conservation and environmental carrying capacity measures within one critical area - the urban fringe. We have noted an apparent direct relationship between 1) urban fringe problems and 2) the physical-environmental constraints of the urban region where the population size, change and density characteristics are similar. Therefore it is recommeded that urban fringe terrain-environment types be represented, where possible, in the final urban region samples.

Table 8 represents a more generalized classification framework than that employed in Part II. Four urban region types are identified corresponding to the four types identified in Part II. These four types are deemed suitable for our purposes here. However it is readily apparent that this classification can be expanded by 1) refining and expanding the column characteristics or by 2) elaborating upon distinctive types.

In addition, it would not be difficult to develop and apply simple quantitative criteria for consistently placing urban regions in their proper type class. For example, slope class intervals could be determined for flat, rolling, and steep terrain and urban regions could then be placed in slope classes according to the proportion of their total area falling within each class. The annual rate of consumption of Class I agricultural land as percentage of total Class I agricultural land available within the urban region is one useful measure of threat to non-renewable resources. The recent activities of federal and provincial environmental agencies to inventory environmental hazards and resources should lend themselves to objective measures for classifying the degree of hazard on an absolute scale of measurement. Distinction between monocentric and polycentric urban agglomerations could be determined by employing a ratio of the population or population density split between the largest urban agglomeration and all other urban agglomerations within the urban region.

For the moment we can apply this classification, together with some notions of population, to a more detailed consideration of the urban region sample.

Table 8

Terrain-Environment Classification for
Producing Urban Region Types*

Urban Region Type	Physiographic Characteristics			Threat to Non-Renewable Resources, eg. agric. land		Environmental Hazard Potential		Regional Urbanization Pattern	
	Flat to Gently Rolling	Steep Slopes Poor Drainage Costly Servicing	Severe Physical Constraints Mountains or Water	Slight	Significant	Minor	Major	Single Urban Nucleation	Poly-nucle-ation
1		X			X†		X		
2			X		X†		X		
3	X			X		X		X	
4	X				X		X		X

† Where the resource is present.

* Characteristics of the urban region type are signified by "X".

Table 9 illustrates five dimensions from which a combined Canadian urban region/urban fringe sample might be drawn. The nominal (4 terrain-environment, 10 provinces) and ordinal (3 absolute, 3 percentage change, 3 density population) classes are ostensibly arbitrary yet could be defended against other dimension and class choices. Theoretically, the number of five-dimension combinations is extremely large (1,080). In reality, many combinations are impossible to satisfy drawing from the universe of Canadian cities. For example, Prince Edward Island has only one urban region thus reducing the maximum number of theoretical combinations by 107 to 973.

Some additional comments on sampling are required. It is assumed that sampling on the urban fringe should be an area rather than location type; that the primary sampling units are areal rather than the actual items comprising the sample population.[70] In order to determine that these area samples do provide adequate representation to growth corridors and to variations in physical characteristics, judgemental non-random samples will have to be identified.

The size of these area samples is also significant. They should be a block rather than fragmented type and could be established by laying down sectors or transects along one or more growth corridors and interstitial slow growth wedges radiating from the built-up urban area. Either sectors or transects would recognize the extensive (rather than intensive) social and economic interactions that exist on the urban fringe. Small area samples would fragment space, actor, and activity relationships to

Table 9

Dimensions Through Which
Urban Region/Urban Fringe
Samples Might Be Drawn

Urban Region/ Urban Fringe Terrain-Environment Type [a]	Absolute Population (1971)	Population % Change (1966-1971)	Population Density [b] (persons/ sq. mi.)	Province
Type 1	Less than 100,000	Less than 5%	Less than 100	Each of the ten provinces
Type 2	100,000 - 1 million	5-14%	100-400	
Type 3				
Type 4	over 1 million	15% or more	over 400	

[a] See Part II, p. 22 for definitions.

[b] In order to ensure that urban regions are of approximately the same area (by pre-selected population size class) it may be necessary to construct modified CD's by aggregating minor civil divisions.

such an extent that important relationships were obscured. In a zone where daily work and leisure activities may encompass broad areas the block sample technique at least recognizes these extensive relationships.

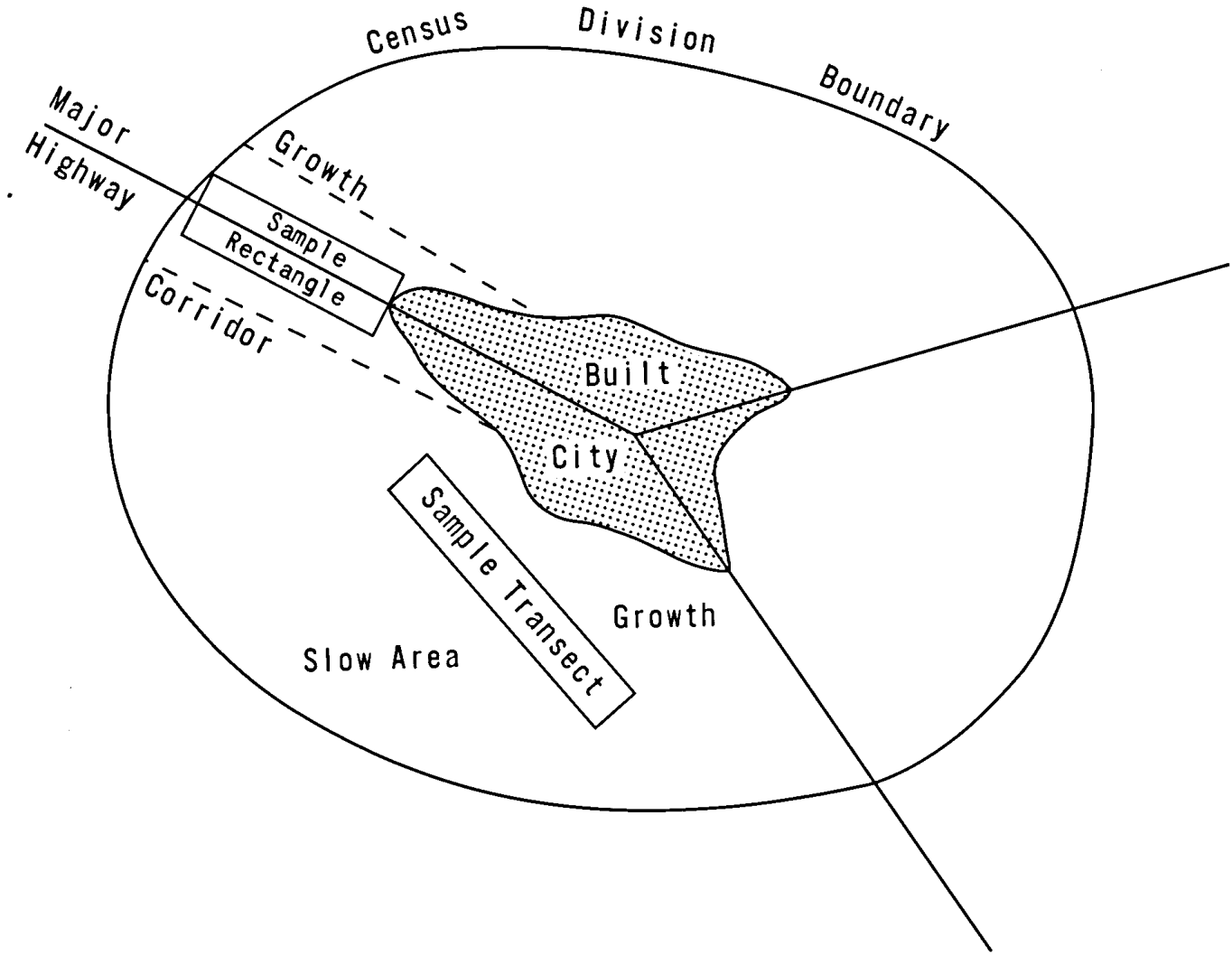
A reasonable size for a sample block located in an urban region might be a rectangle (perhaps a sector or transect) 2 miles wide and radiating out from the edge of the built city for a distance of 10 to 20 miles and containing from 13,000 to 26,000 acres. No doubt the number, size, shape, and orientation of the sample blocks would need to be adjusted to each urban region and would be very much influenced by external factors such as size of urban region, size of sample and research resources.[71] Figure 4 illustrates the concept of the urban fringe block sample.

Land use data should be recorded on base maps within two map scale ranges; 1) between 1:30,000 and 1:50,000 at the sample block level, and 2) between 1:50,000 and 1:200,000 at the generalized urban region level. The most appropriate scales cannot be determined until the range of sample block sizes have been selected.

All block samples should be examined for two points in time in order to identify the dynamic aspects of land use on the fringe. A ten year time period phased as closely as possible to the decennial census seems appropriate. However, this time period can be extended or contracted according to the availability of quality photography and the rate at which land uses undergo change.[72]

Figure 4

Schematic Illustration
of the
Urban Fringe Block Sample



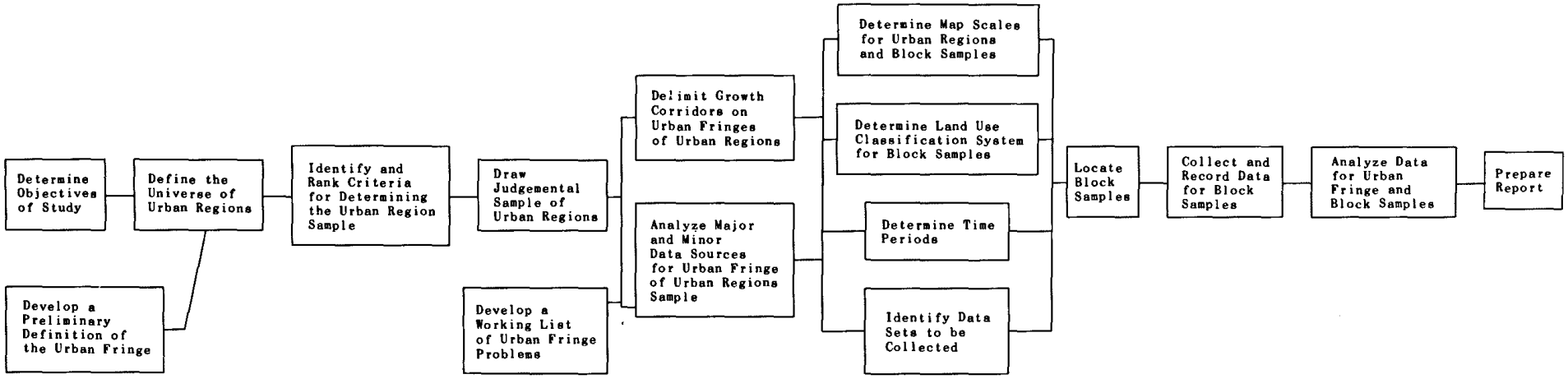
An important result of these comparative analyses will be the production of population density change data that reflect regional, socio-economic, and environmental differences within and among urban regions. Land consumption rates (acres per 1,000 population - the reciprocal of population density) and land absorption rates (acres of land per 1,000 population increase) for gross and net residential densities could become very useful tools for land use planning on the urban fringe, and particularly for identifying future conflict zones where the land's carrying capacity cannot absorb future population levels.

Study Methodology - Sequence of Tasks

Under five separate sections Part III has examined a broad spectrum of issues, problems and recommendations related to an appropriate methodology for urban fringe land use research. In this final section of Part III we will relate the methodology, in the form of a sequence of tasks to an urban fringe research program contemplated by the Lands Directorate. This sequence of tasks is illustrated in Figure 5.

The first step in the urban fringe research program will involve the explicit determination of objectives. These objectives will have a fundamental influence on the ultimate characteristics of the methodology. If urban fringes for small urban agglomerations are to be studied the reliance on data sources will have to be shifted from standard data files to custom data. This proposed national comparative urban fringe methodology, as conceived, is just one expression of the Lands Directorate's

Flow Diagram
For
Research Program



intention to examine "the nature, causes and implications of land use changes in Canada's critical areas". But when examined apart from this broader objective, it becomes obvious that urban fringe land use research will benefit by serving more explicit secondary objectives that extend it beyond an introductory analysis of the qualitative and quantitative description of urban fringes across Canada; identifying similarities and differences in their form and function; explaining the gross determinants of their structure and change; and proposing hypotheses for secondary research.

At the same time it will be necessary to provide a preliminary definition of the urban fringe. A working definition, suitable for proposed research has been provided in section three of Part III. However, this definition may require modification in response to Study objectives best perceived by the contractor. For example a decision by the Lands Directorate to include small urban agglomerations in the study would necessitate a reformulation of the urban fringe definition. It should be recognized at this stage that a precise, logically consistent definition based on comprehensive and integrated research must await the outcome of the national comparative study.

The urban fringe definition will assist in the defining of the Study's universe of urban regions. Urban regions that do not contain a peripheral zone consistent with the fringe definition will be excluded from the universe unless specific exceptions are permitted. Urban regions containing strong development controls restricting urban expansion (green

belts, agricultural land freezes) or highly diffused, multi-nucleated regions such as the Chicoutimi-Jonquiere or Niagara urban regions are cases in point.

We have indicated that the urban region universe should contain the twenty-two CMA's in Table 3. It might also include the thirty-eight census agglomerations with 25,000 or more population as of 1971. Thus defined the universe of urban regions will contain sixty members and will be empirically delimited by the Census Division.[73]

A non-random judgemental sample of urban regions will be drawn according to its ability to fulfill a number of criteria that are selected and ranked on the basis of their perceived importance. In the text supporting Table 9 we suggested that the sample should be drawn in such a manner that a maximum number of possible classes were represented from five dimensions treating 1) terrain-environment type, 2) absolute population, 3) percentage change of population, 4) population density and 5) the ten provinces. Because the urban fringe definition implicitly considers travel time, time-distance will be automatically represented in the final sample.

With a working list of urban fringe problems developed from the literature as background, the sample of urban regions and their urban fringes are analyzed employing data recommended in Table 5. From this analysis appropriate growth corridors and zones of slow growth can be delimited within the urban fringe portions of the urban region sample.

To assist in the analysis two map scales are selected, a large scale for use in areas covered by sample blocks and a much smaller scale for entire urban regions. A single land use classification will be applied to land use analysis in urban regions and urban fringe sample block areas. The appropriate time periods and data sets to be collected will be determined at this point.

Sample blocks are to be located within the urban fringe. These blocks may take the form of rectangles or sectors located along growth corridors or may be rectangular transects randomly oriented in slower growth segments of the urban fringe. At least one sample block representing growth corridors and slow growth zones should be located in each urban region. Because of the inevitable resource constraints implicit in research that includes detailed land use analysis, a high priority will be placed on identifying a relatively few blocks, both within and among urban fringes, that we can presume to be representative of the universe of blocks.

Major data sources including standard federal census data and special custom air photo land use information will be collected and will undergo primary analysis to provide descriptive and explanatory understanding of form, structure, and dynamics of Canadian urban fringes. In addition the report will contain the first precise definition and delimitation of urban fringes at a national scale. It should also present a set of hypotheses that define significant secondary research.

PART IV

SUMMARY AND CONCLUSIONS

Here, the contents of the report are summarized briefly and conclusions are advanced. As the last section of Part III, "Study Methodology - Sequence of Tasks" has summarized the principal findings of the methodology in a relational context there is no reason to duplicate those findings in detail.

Summary

Problems of the urban fringe are not new in Canada - they have merely been rediscovered. Our failure to recognize these problems and respond adequately to them results from our inability to agree upon the urban fringe "problems", to locate the urban fringe, and to properly collect and analyze information describing the urban fringe phenomenon.

Definitions of the urban fringe have been found wanting. Either they are the end result of highly specific and geographically limited empirical research or they are vague, untested presumptions. Urban fringe problems suffer from a bias of perspective; differing very much according to the interests and concerns of the observer. Most urban fringe problem "lists" can be readily partitioned according to the central city, fringe hamlet, conservationist, agricultural, or other interests indicated in the phrasing of the problems. Data for the urban fringe have been inadequate or non-existent. The recent, heightened concern for the urban fringe will ensure that more data will be forthcoming but not that these data will necessarily contribute to a more wholistic and integrated appreciation for the urban fringe.

A review of government-sponsored urban fringe research and policy making indicates that the contribution has been significant over a long period of time. The federal government has played a surprisingly active role, thus offering a precedent for its current interests. Due to the peculiar constitutional division of powers related to land use planning the federal involvement has concentrated on generating research, and providing the resulting findings and expertise to other levels of government.

Some provinces - Ontario, Alberta, and Manitoba in particular - have demonstrated a considerable interest in programs and policies to redress urban fringe problems. While the findings of these provinces are of great interest nationally, their contribution to a national understanding is limited by the highly individualized background to problems and the unique character of responses.

Concerned with urban fringe problems, most larger urban municipalities have instituted sizable planning and research programs that pay explicit attention to the fringe zone. Despite the great diversity of experiences most municipalities reveal the dual concern for rationalizing urban boundaries to conform with the urban perception of the fringe problem and for limiting or deflecting growth to other locations with the hope that pressure on the fringe will be reduced.

Part III of the report presents the proposed methodology. First a definition of the urban fringe - suitable for guiding subsequent research - is determined. Then a practical method is presented for delimiting the

urban fringe within the context of the urban region. The need for a method of drawing a sample of urban regions and for locating block samples of the fringes of these regions is demonstrated. Data needs and sources are evaluated.

Conclusions

This report recommends a comparative urban fringe study methodology that will provide the first national perspective on the urban fringe through its generation of a rich set of land use and related data. As well as adding significantly to our appreciation of the structure and dynamics of land use it will also open new avenues to fruitful research and policy making.

This is clearly a desirable and opportune task. Concern for land use issues has surfaced at all levels of government and among a wide variety of private and public interest groups in the private sector. It is interesting to observe that the urban fringe forms the interface between these diverse interests.

Good policy must be sustained by good information. The continuation of land use conflicts on the urban fringe bears out this relationship. It would only seem reasonable, that the federal government - to a large degree responsible for the nature of the urban fringe as a result of a diversity of direct and indirect policies affecting land - should play a key role in modifying the urban fringe.

FOOTNOTES

(1) The term "urban fringe" (and occasionally "fringe") employed here is intended to be generally synonomous with the terms "rural-urban fringe", "rural fringe", and "suburban fringe" used in the literature. The confusion of terminology in the literature is acknowledged. For the moment, we will consider the fringe to be a circumferential band of land beginning at the edge of the built city and extending 5 to 10 miles into the countryside. A more specific definition will be offered in Part III.

(2) Economic Council of Canada, Fourth Annual Review, The Canadian Economy From the 1960's to the 1970's (Ottawa: Queen's Printer, 1967), pp. 194-196.

(3) Commission of Conservation, Report of the First Annual Meeting, 1910 (Ottawa: King's Printer, 1910), p. 3.

(4) Thomas Adams, "Modern City Planning", National Municipal Review (June, 1921), quoted in Alfred Buckley, "Modern City Planning" Journal of the Town Planning Institute of Canada I, No. 16 (1921), 4.

(5) Final Report of the Subcommittee, Housing and Community Planning, Advisory Committee on Reconstruction, March 24, 1944, C. A. Curtis, Chairman (Ottawa: King's Printer, 1946).

(6) Final Report, pp. 161-165.

(7) It is a debatable question whether the increased availability of NHA funds has increased the volume of construction on the urban fringe or, by placing pressure on demand without increasing supply, has forced up land and construction costs. See L. B. Smith, Housing in Canada, Urban Canada: Problems and Prospects, Research Monograph 2 (Ottawa: CMHC, 1971), pp. 70-77.

(8) The Senate of Canada, Report of the Special Committee on Land Use in Canada (Ottawa: Queen's Printer, 1964).

(9) Joan Hind-Smith, "The Impact of Urban Growth on Agricultural Land: A Pilot Study", in Resources for Tomorrow, Conference Background Papers, Supplementary Volume (Ottawa: Queen's Printer, 1962), 156-179, and A. D. Crerar, "The Loss of Farmland in the Growth of Metropolitan Regions of Canada", in Resources for Tomorrow..., 181-195.

(10) Here, the writer assumes that the efforts of these ministries are well known to the readers of this report and that he can add little to this present level of understanding.

(11) Ontario, Department of Treasury and Economics, Design for Development, Phase I, 1966.

(12) Ontario, Department of Treasury and Economics, Design for Development, Phase II, 1968.

(13) Design for Development, Phase II, p. 4.

(14) Design for Development, Phase II, pp. 1-3.

(15) Seven of the other nine provinces have instituted or are now examining application of regional government reform.

(16) Ontario, Department of Treasury and Economics, Design for Development, Toronto Centred Region, 1970.

(17) Originally a 50 percent tax, it is presently being reduced to 25 percent after the Federal Minister of Finance recently announced that it would not be an eligible deduction in computing federal income taxes.

(18) I have chosen not to discuss other policies and programs (such as the Ontario Housing Corporation and the Land Transfer Tax Act) that while having a significant impact on the urban fringe were created for other purposes.

(19) Among a total of seven regional commissions only the Edmonton and Calgary commission face the problems of rapid urbanization at present.

(20) For additional information see Province of Alberta, Task Force on Urbanization and the Future, The Role of Regional Planning, November, 1971.

(21) Province of Alberta, Task Force on Urbanization and the Future, Task Committee Reports, August, 1972, pp. 55-63.

(22) Problems pertaining to the Calgary and Edmonton urban fringes are found in Province of Alberta, Task Force on Urbanization and the Future, Choices for Metropolitan Growth, March, 1972.

(23) Publications particularly relevant to the fringe are Technical Reports No. 4, Urban Residential Land Development; No. 4B, An Overview of Rural Subdivision in Alberta; No. 8, Land Use Policy - Population Growth; and No. 9, Land Ownership Rights. Summary Reports are available also.

(24) For a brief survey see E. Beecroft, "Local Government in Canada", Comparative Local Government, V (Summer, 1971), 20-22.

(25) Municipal Planning Branch, "Progress Report on the Winnipeg 'Region' Planning Study", Winnipeg, 10 May, 1972, p. 4.

(26) Submission to Planning and Priorities Committee of Cabinet on the Winnipeg "Region" Planning Study (Winnipeg: Department of Municipal Affairs, August 6, 1971), p. 1.

(27) Submission, p. 2.

(28) Winnipeg Region Study, The Nature of Demand for Exurbia Living (Winnipeg: Department of Municipal Affairs, February, 1974).

(29) This typology is by no means complete nor are the categories mutually exclusive. Parameters suggested are the main or determining ones, but not the only ones used in arriving at a type. The typology's purpose, at this time, is to provide us with a reasonable means for selecting and reviewing a representative sample of metropolitan planning programs in Canada. We will return again to a discussion of this typology in Part III,pp.68-69.

(30) The term "infilling" refers to a process of developing, for urban uses, non-urban interstitial spaces on the urban fringe previously by-passed by urban development.

(31) Metropolitan Area Development Committee, Regional Development Plan for Halifax-Dartmouth Metropolitan Area, Regional Map and Technical Summary (Halifax: Minister of Municipal Affairs, 1973).

(32) For more information see Royal Commission on Education, Public Services, and Provincial-Municipal Relations, J. Graham, Chairman (Halifax: Department of Municipal Affairs, 1974).

(33) For a comprehensive review of this development see David Baxter, "British Columbia Land Commission Act: A Review", The Management of Land for Urban Development (Ottawa: Canadian Council on Urban and Regional Research, 1974).

(34) In chronological order the titles are, Economic Aspects of Urban Sprawl, 1956; Land for Living, 1963; Dynamics of Residential Land Settlement, 1963; Countryside to Suburb, 1963; The Urban Frontier, Parts 1 and 2, 1963; and What Price Suburbia, 1967.

(35) An American Geographer, John Thompson, has worked on a subject akin to this. On the perimeters of several U.S. urban areas he has demonstrated the presence of a narrow zone in which raw land values decline rapidly from urban to agricultural value. He has named this zone the urban frontier. More recently he has searched for rural non-farm residential design attributes that might serve as surrogates for land values in locating the urban frontier. To the writer's knowledge this work has not yet been published.

(36) Calgary Planning Department: Residential Development in Calgary: Inventory and Prospect (Calgary: Planning Department, December, 1973), p. vii.

(37) Regional Municipality of Waterloo, "Planning the Regional Plan", Conestoga Wagon, II (October, 1974).

(38) Economic Council of Canada, Fourth Annual Review, pp. 194-197.

(39) The reports of agencies representing urban development, conservation, recreation, and agricultural interests are vulnerable to this approach.

(40) L.H. Russwurm, The Urban Fringe in Canada: Problems, Research Needs, Policy Implications, Report submitted to the Research Branch, Ministry of State, Urban Affairs, Ottawa, July 1973. Before considering fringe problems he develops an urban fringe land space resource activities matrix. In this matrix the row attributes (present use, property, and purpose) are matched with column attributes (location and resources) for thirteen distinct classes of major land use activities. Urban fringe problems can be logically examined in the context of human activities with this matrix. See his Report, pp. 17-21 for a detailed discussion.

(41) Russwurm, The Urban Fringe, pp. 45-72.

(42) N.H. Lithwick, Urban Canada: Problems and Prospects (Ottawa: CMHC, 1970), pp. 19-35.

(43) Consider the impact of legislated greenbelts and deferred farm property taxes - initially to preserve open space and encourage farming-on the supply and price of raw land for urban development. In both cases it can be demonstrated that these policies elsewhere have either reduced the long run or short run supply of raw land thus imputing a scarcity value into other developable land. See Max Neutze, The Price of Land and Land Use Planning: Policy Instruments in the Urban Land Market, Paris: Environment Directorate, Organization for Economic Co-operation and Development, 1973, p.18, and M. Clawson and P. Hall, Planning and Urban Growth: An Anglo-American Comparison, Baltimore: Johns Hopkins Press for Resources for the Future, 1973, pp. 184, 263.

(44) For a clear presentation of the theory of ecological succession in the biological context see R.L. Smith, Ecology and Field Biology (2nd ed.; New York: Harper and Row, 1974), Chap.9. It should be noted that the brief discussion following is only suggestive and cannot explore adequately the deficiencies and strengths of the analogy.

(45) Smith, Ecology, p. 258.

(46) Urban population was defined by the 1971 Census as all people living in incorporated cities, towns, and villages containing a population of 1,000 or more. Unincorporated places having a minimum population of 1,000 and population density of 1,000 people per square mile or more were also included. The population of the built up fringes of these settlements were also included if they met the same population and density criteria. The definition of urban population by the 1966 Census was essentially the same.

(47) The writer is employing a land density coefficient of 12 people per developed acre for urban regions of 100,000 population or more and a rate of 10 people per developed acre as an average for all urban development. See Ontario Department of Municipal Affairs, Urban Land Uses in Ontario: Areas and Intensities (Toronto: D.M.A., 1969), Figure 3, for comparable rates. Other estimates are provided in G. Gad, "Methodological Problems in Measuring Urban Expansion", in The Form of Cities in Central Canada, ed. by L.S. Bourne et al. (Toronto: University of Toronto Press, 1973), Table 2.1. The many, limiting assumptions implicit in these calculations are acknowledged. However the relative magnitudes remain instructive.

(48) Between 1966 and 1971 the small urban regions have lost population to the large urban regions while both the large and small urban regions have lost some population to the rural areas. During this period the non-farm rural population increased its proportion of total population from 16.9 percent in 1966 to 17.3 percent in 1971. This represents an increase of more than 363,000 people. We suspect that the majority of these non-farm residents are located on the outer margin of the urban fringes of the large regions.

(49) A CMA is defined as the main labour market of a continuous built-up area having a population of 100,000 or more. See, Information Canada, Canada Year Book, 1973 (Ottawa: Information Canada, 1973), p. 185. CMA's encompass a larger area and population (an additional 1.6 million persons) than the large urban regions discussed above. This additional population resides in the low density portion of the urban fringe.

(50) By coincidence the mean percentage increase of population in CMA's between 1966 and 1971 is 11.1 while the median percentage increase lies between 9 and 10. Thus it seems reasonable to contrast the two halves of the percentage distribution.

(51) George S. Wehrwein, "The Rural-Urban Fringe", Economic Geography, XVIII (July, 1942), pp. 217-228.

(52) Robin J. Pryor, "Defining the Rural-Urban Fringe", Social Forces, XL (December, 1968), p. 62.

(53) Pryor, "Defining the Rural-Urban Fringe", p. 61.

(54) L.H. Russwurm, "Urban Fringe and Urban Shadow" in Urban Problems: A Canadian Reader, ed. by R. Krueger and R. Bryfogle (Toronto: Holt, Rinehart and Winston, 1971), p. 108.

(55) Pryor, "Defining the Rural-Urban Fringe", and Russwurm, The Urban Fringe in Canada: Problems, Research Needs, Policy Implications.

(56) Strictly speaking factor analysis should be used to test a theoretical model. Thus, it is more appropriate to view it as a deductive technique. However, in keeping with current, if misplaced, practice we will consider it here.

(57) L.H. Russwurm, "Urban Fringe and Urban Shadow in the Waterloo-Southeast Wellington County Area Land Space Matrix", in The Waterloo County Area Selected Geographical Essays, ed. by A.G. McLellan (Waterloo: University of Waterloo, 1971), pp. 98-111. An example of the application of factor analysis as well as an explicit technique, Dissimilarity Analysis, for grouping or regionalizing factors in geographic space is presented in C.R. Bryant, "An Approach to the Problem of Urbanization and Structural Change in Agriculture: A Case Study from the Paris Region, 1955 to 1968", Geographic Annaler LVI, Ser. B (1974), pp. 1-27.

(58) R. Chevallier, A. Fontanel, G. Grau and M. Guy, "Application of Optical Filtering to the Study of Aerial Photographs", Photogrammetria XXVI (1970), pp. 17-35; N. Gramenopoulos, Automatic Thematic Mapping and Change Detection of ERTS-A Images, Report submitted to the Goddard Space Flight Centre, Greenbelt, Md., July, 1974.

(59) The University of Waterloo has Picpack ERTS Four software programs for image processing. The University of Western Ontario has an Optronics Photoscan drum scanner and the University of Toronto and Laval have Optical Fourier Transformer lens systems.

(60) See p. 44 above.

(61) These problems are well documented in the following: M. Clawson, Suburban Land Conversion in the United States (Baltimore: Johns Hopkins Press, 1971), A.A. Schmid, Converting Land from Rural to Urban Uses (Washington, D.C.: Resources for the Future, 1968), and G. Gad, "Methodological Problems in Measuring Urban Expansion" in The Form of Cities in Central Canada, ed. by L.S. Bourne et al. (Toronto: U. of Toronto Press, 1973), pp. 16-33. Other articles by L.S. Bourne and J.W. Simmons, and G. Hodge in this last reference are also pertinent.

(62) Clawson, Suburban Land, p. 3.

(63) L.R.G. Martin, Land Use Dynamics on the Toronto Urban Fringe. Report submitted to the Lands Directorate, Environment Canada, June 1974.

(64) Martin, Land Use Dynamics, p. 58.

(65) Lands Directorate, "An Overview of Land Use Changes in Canada", Ottawa, September 9, 1974. (Mimeographed)

(66) Some readers may wish to challenge this viewpoint. It is our view that national comparative studies having policy and longer term evaluative objectives must shape themselves to utilize federal census information. Census data gaps may often be filled by special surveys and clever analytical designs but federal research dependent entirely on costly special surveys or the cooperation of various independent sources often falls short of expectations.

(67) The CA is a statistical area consisting of an urban centre with a population of at least 1,000 and an adjacent urbanized area of at least 1,000 population. The entire area must have a minimum density of 1,000 persons per square mile.

(68) See Gad, "Methodological Problems", p. 25, for support.

(69) Background investigation undertaken for the preparation of Part II and particularly for Calgary, Winnipeg, and Halifax as well as the writer's work in Toronto support this view. See also, Lakehead Planning Board, Rural Residential Report (Thunder Bay: Lakehead Planning Board, February, 1974).

(70) For a detailed discussion see John Holmes, "Problems in Location Sampling", Annals, Association of American Geographers LVII (December, 1967), pp. 757-780.

(71) Our experience in the Land Use Dynamics Study indicates that land uses on a 13,000 acre parcel could be photo interpreted and transposed to a base map with a scale of 1:50,000 in two and one-half man days. This assumes that the photography scale is 1:16,000; that supporting documentation (land use maps, soil surveys, etc.) is readily available; and that the photo-interpreter is experienced.

(72) In his work on the Toronto urban fringe, Punter employed a 16 year time period to illustrate land use changes for 4 sample areas, 2 of which were located in a more isolated, slower changing part of the urban fringe. See J.V. Punter, The Impact of Exurban Development on Land and Landscape in the Toronto-Centred Region, 1954-1971, Report submitted to the Policy Planning Division (Ottawa: CMHC, 1974).

(73) It should be noted that seven of the larger urban regions will be composed of two or more Census Divisions. These urban regions and their Census Division code numbers are: London (8, 26); Montreal (6, 11, 15, 18, 28, 35, 36, 59, 70, 71, 72); Ottawa-Hull (Prov. of Ont., 33, Prov. of Que., 24, 25, 51); Quebec (37, 47, 53, 54); Saint John (6, 11); Toronto (16, 32, 36, 49, 54); and Vancouver (5, 11, 15).

APPENDIX

Bibliographic References for Figure 8

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