A DEVELOPMENT POTENTIAL MODEL
FOR THE VANCOUVER METROPOLITAN AREA

by

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We accept this thesis as conforming to the required standard:

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December, 1972.
Abstract

The focus of this study is on means by which the spatial distribution of housing development can be explained. This involved firstly (I) identification of potential determinants of residential location and the verification thereof, and secondly (II) investigation into the applicability of the use of Clark's Theory of Exponentially Declining Densities as a predictor of housing unit completions.

(I) Interviews with sixty-three developers in the Greater Vancouver Area were used to rank criteria used in their location decision-making. Regressions of some of the more important criteria were attempted with housing completions as the dependent variable.

Analysis of the data demonstrates that housing unit completions of a subarea are strongly related to both its unused and total housing potential. The data does not support the developers' contention that relative land price is an important locational determinant. Travel time from the central business district is not in itself a significant variable in explaining the spatial distribution of housing unit completions.
(II) Less than 50% of the variation of population density is explainable in terms of distance from the CBD in the manner of Clark's relation: Population/Area = Ae^{-bd} where d is the distance from the central business district, and A and b are constants.

Considerably better results (59% to 74% of the variation) are obtained with the inverse travel relations:

\[
\text{Population/Area Zoned Residential} = \frac{C_1}{t}
\]

and

\[
\text{Housing Units/Area Zoned Residential} = \frac{C_2}{t}
\]

where t is the travel time from the central business district.

The existence of unused potential in a subarea as defined by the difference between the density observed and the density calculated (by Clark's Theory or by the Inverse Travel Time Relation above) is a significant predictor variable of whether or not residential construction will take place. However, the magnitude of the unused potential thus calculated is not a significant determinant of the actual number of housing unit completions.
<table>
<thead>
<tr>
<th>Table of Contents</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title Page</td>
<td>i</td>
</tr>
<tr>
<td>Abstract</td>
<td>ii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>viii</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>ix</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Organization of the Report</td>
<td>5</td>
</tr>
<tr>
<td>A Conceptual Overview of the Residential Development Process</td>
<td>7</td>
</tr>
<tr>
<td>The Predevelopment Landowner's Decision</td>
<td>8</td>
</tr>
<tr>
<td>The Developer's Three Stage Location Decision: to Consider, to Purchase, and to Develop Land</td>
<td>9</td>
</tr>
<tr>
<td>The Householder's Decision</td>
<td>12</td>
</tr>
<tr>
<td>Models of the Development Process</td>
<td>13</td>
</tr>
<tr>
<td>The Housing Market</td>
<td>17</td>
</tr>
<tr>
<td>Definition of Housing Demand</td>
<td>17</td>
</tr>
<tr>
<td>Factors Affecting Housing Demand</td>
<td>18</td>
</tr>
<tr>
<td>1. Demographics</td>
<td>18</td>
</tr>
<tr>
<td>2. Income</td>
<td>19</td>
</tr>
<tr>
<td>3. Prices and Rents</td>
<td>20</td>
</tr>
<tr>
<td>4. Credit Variables</td>
<td>20</td>
</tr>
<tr>
<td>5. Other Variables</td>
<td>21</td>
</tr>
<tr>
<td>Factors Affecting Housing Supply</td>
<td>22</td>
</tr>
<tr>
<td>Models of the Housing Market</td>
<td>23</td>
</tr>
<tr>
<td>Comment</td>
<td>28</td>
</tr>
<tr>
<td>Models Concerned with the Housing Patterns in General Terms</td>
<td>Page Number</td>
</tr>
<tr>
<td>------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Burgess' Concentric Zone Theory</td>
<td>29</td>
</tr>
<tr>
<td>Hoyt's Sector Theory</td>
<td>30</td>
</tr>
<tr>
<td>Theory of Multiple Nuclei</td>
<td>30</td>
</tr>
<tr>
<td>Clark's Theory of Exponentially Declining Densities</td>
<td>31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Models Involving Transportation Costs and Spatial Preferences</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Kain's Model</td>
<td>32</td>
</tr>
<tr>
<td>2. Alonso's Model</td>
<td>33</td>
</tr>
<tr>
<td>3. Wingo's Model</td>
<td>34</td>
</tr>
<tr>
<td>Comment</td>
<td>35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Models of Residential Location</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ad Hoc Allocations</td>
<td>36</td>
</tr>
<tr>
<td>The CATS Model</td>
<td>36</td>
</tr>
<tr>
<td>The U.N.C. Model of Land Use Succession</td>
<td>37</td>
</tr>
<tr>
<td>Harris' Stochastic Model of Urban Development</td>
<td>39</td>
</tr>
<tr>
<td>Hill's EMPIRIC Model</td>
<td>40</td>
</tr>
<tr>
<td>The Lowry Model</td>
<td>41</td>
</tr>
<tr>
<td>Bay Area Simulation Study (BASS)</td>
<td>42</td>
</tr>
<tr>
<td>Projective Land Use Model (PLUM)</td>
<td>43</td>
</tr>
<tr>
<td>Herbert and Stevens' Model of Market Demand</td>
<td>44</td>
</tr>
<tr>
<td>A. D. Little (San Francisco) Model of Market Supply</td>
<td>45</td>
</tr>
<tr>
<td>Sears' Model</td>
<td>46</td>
</tr>
<tr>
<td>Discussion of the Models of Residential Location</td>
<td>47</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>----</td>
</tr>
<tr>
<td>1. Contextual</td>
<td>47</td>
</tr>
<tr>
<td>2. Forecasting the Effects of Public Policies</td>
<td>47</td>
</tr>
<tr>
<td>3. Market Equilibrium and Disaggregation</td>
<td>48</td>
</tr>
<tr>
<td>4. Locational Criteria</td>
<td>49</td>
</tr>
<tr>
<td>5. Spatial Disaggregation</td>
<td>49</td>
</tr>
<tr>
<td>6. Intra-regional Mobility</td>
<td>50</td>
</tr>
<tr>
<td>7. Aspects of Renewal and Redevelopment</td>
<td>50</td>
</tr>
<tr>
<td>Scope and Methodology</td>
<td>52</td>
</tr>
<tr>
<td>The Approach</td>
<td>52</td>
</tr>
<tr>
<td>Data Gathering Technique</td>
<td>53</td>
</tr>
<tr>
<td>Limitations of the Questionnaire Approach</td>
<td>55</td>
</tr>
<tr>
<td>Limitations of the Questionnaire</td>
<td>56</td>
</tr>
<tr>
<td>The Sample</td>
<td>57</td>
</tr>
<tr>
<td>Empirical Results of the Questionnaire</td>
<td>61</td>
</tr>
<tr>
<td>Trends Identified</td>
<td>67</td>
</tr>
<tr>
<td>Political Climate</td>
<td>68</td>
</tr>
<tr>
<td>Hypotheses and Measurement of Variables</td>
<td>70</td>
</tr>
<tr>
<td>The Study Area</td>
<td>70</td>
</tr>
<tr>
<td>Hypotheses 1 to 19</td>
<td>71</td>
</tr>
<tr>
<td>Statistical Comment</td>
<td>84</td>
</tr>
<tr>
<td>Regression Results</td>
<td>87</td>
</tr>
<tr>
<td>Conclusion</td>
<td>97</td>
</tr>
<tr>
<td>Section</td>
<td>Page Number</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Extentions</td>
<td>100</td>
</tr>
<tr>
<td>Footnotes</td>
<td>103</td>
</tr>
<tr>
<td>Bibliography</td>
<td>106</td>
</tr>
<tr>
<td>Appendix A: The Questionnaire</td>
<td>115</td>
</tr>
<tr>
<td>B: Map of 1961 Census Tracts</td>
<td>128</td>
</tr>
</tbody>
</table>
List of Tables

Table | Page
--- | ---
I Evaluation of Location Factors By All Developers | 62
II Evaluation of Location Factors By Developers of Multiple Family Dwellings | 63
III Evaluation of Location Factors By Developers of Single Family Dwellings | 64
IV Evaluation of Location Factors By Subdividers | 65
V Regression Results of "Measures of Attractiveness" | 88
VI Regression Results of "Unused and Total Potential" | 89
VII Regression Results of Log(Pop/Total Area) = -bd + c | 91
VIII Regression Results of Pop/Area Zoned Residential = C₂/time | 92
IX Regression Results of Housing Units/Area Zoned Residential = C₂/time | 93
X Regression Results of Completions vs. Dummy Variable Representing Existence of Unused Potential as Determined by Clark's Theory | 96
XI Regression Results of Completions vs. Dummy Variable Representing Existence of Unused Potential as Determined by the Inverse Travel Time Relation | 96
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A DEVELOPMENT POTENTIAL MODEL FOR
THE VANCOUVER METROPOLITAN AREA

Introduction

Rapid population growth in the Vancouver Metropolitan Area is expected. The Lower Mainland Regional Planning Board in "Population Trends in the Lower Mainland 1921-1986 Technical Report" estimates a population increase of approximately 14% during each of the next three five-year periods. To add emphasis, the report's estimate of the 1971 population was low by five per cent (1,026,000 compared to 1,082,352 from the 1971 Census). The report predicts population increases during the period of 1971 to 1986 of 35% for the Burrard Penninsula, 56% for the North Shore, and 91% for the South Shore. Further the report predicts astounding population increases during the same period of 100%, 106% and 119% for the municipalities of Port Moody, Richmond and Delta respectively.

The problems facing such phenomenal growth are awesome: limited availability of developable land; upward pressures on land prices especially in residential areas already sewered
or intended to be sewered in the immediate future; increased financial strain on municipalities for new servicing; increased pressure on transportation systems; and more traffic and population congestion in the Burrard Peninsula. Viewed from the totality of things, there are additionally the vast social and ecological problematical complexities which result from these factors and others.

In order to begin to cope with some of these problems, many questions remain unanswered relating to the manner in which residential development and redevelopment will occur. Which locations are most likely to be developed? And in what sequence will they be developed? And where? With appeal to which income groups? To which household styles? Which income groups and household styles will not be adequately provided for? Where will redevelopment occur? In what forms? What existing housing will be destroyed to make way for new higher density housing?

This study is a first step toward answering some of these questions. It deals primarily with factors which may be used as predictors of future housing completions. The analytical investigation involves two approaches: one, the identification of criteria used in developers'
locational decision making. Application of these criteria is made to subareas of the urban region for use in "explaining" housing unit completions through regression; two, the investigation of Clark's Theory of Exponentially Declining Densities for use as a potential model. Housing unit completions are regressed against the unused housing potential as determined by the difference between the density calculated and the density observed.

Among the factors affecting the ultimate location of new housing are municipal policy decisions. For example, land previously unavailable for development may suddenly become available. It was recently announced that in Port Moody a new large housing development is to be undertaken. This decision will likely have somewhat of a replacement effect on new housing in the surrounding areas of Coquitlam and Port Coquitlam. An example of a recent policy decision having a restrictive effect on construction is that enabling the Surrey municipality, under Procedural Bylaw 3690, to impose a levy of $530.00 per lot before giving rezoning or subdivision approval. This will have the effect of encouraging developers, especially those with tight financial constraints,
to locate elsewhere. The model then, must necessarily operate within the confines of the existing zoning, building and subdivision bylaws and hopefully may be useful in forecasting the impact of changes in municipal policies.
Organization of the Report

Attempts to develop quantitative models of the spatial aspects of urban development for use as planning tools has developed essentially since about 1960 following a few important generalized descriptions of city patterns. In reviewing the literature, I shall try to show how a number of these quantitative models relate to the residential development process, to the market for urban land, and to the descriptions of city patterns. First, a conceptual overview of the residential development process will be presented. This is followed by a discussion of the housing market in terms of factors affecting supply and demand along with some of the more notable analyses of controversial issues of the marketplace. Next is a description of seven generalized models of housing patterns which precedes discussion of the more important quantitative models of the spatial aspects of residential development. The task involves some risk of misrepresentation since in focusing on the essence of the models' structures and the differences between them, the models may not be adequately documented.
"Scope and Methodology" outlines the two approaches used in the "explanation" of housing unit completions. First, the behavioral approach using the questionnaire is outlined along with a description of the survey sample. A discussion of the results of the questionnaire follows. The hypotheses evolving as a result of the questionnaire are then introduced along with those of the second approach, that using potential models based upon Clark's Theory of Exponentially Declining Densities. The results of the regressions testing the nineteen hypotheses are then discussed followed by the conclusion and suggestions for further research in the direction of the work presented here.
A Conceptual Overview of the Residential Development Process

The sequence of states in the development of a parcel of land can be traced from its initial undeveloped state, through various stages of the development process, and finally to the state of active residential use by a household. More precisely, the stages may be described as follows:

1. The land is in an undeveloped state. It may be felt to have development potential which leads to...

2. The state of being actively considered for development in which a developer and the landowner have contacted one another regarding the possible sale of the land. The developer's decision to purchase the land leads to...

3. The state of being programmed for development. The developer formulates definite ideas of the timing and character of development. His decision to begin development leads to...

4. The state of active development in which physical development of the land takes place. In the case of residential development new housing is made available which leads to...

5. The state of active residential use resulting from a householder's decision to occupy the dwelling.
The Predevelopment Landowner's Decision

The landowner's decision to hold or sell the land is based upon the income and satisfaction he presently receives and expects to receive from the land as well as the land's present market value and his expectations about its future value. The income aspect of this decision includes such factors as net annual holding cost of the land, costs incurred in shifting to another investment and the opportunity cost of capital. The satisfaction received from the land is dependent upon such qualitative factors as his attitude toward farming as a way of life, the land as a home as opposed to a residence, love of the land, privacy, and status.

The landowner weighs the factors relating to his decision in the contextual framework of public policy (taxation; capital improvement and services policies; costs of transportation, water, sewerage and schools; and subdivision regulation, building codes, zoning and land use plans) and socioeconomic factors (economic structure and growth prospects of the urban area; condition of the local housing market, concentration and competition in the local development industry; and the prevailing psychology of the period).
The Developer's Three Stage Location Decision: to Consider, to Purchase, and to Develop Land

In his decision to consider land the developer may follow one of two approaches. He may identify a demand for a particular type and price range of housing, formulate crude site specifications and then begin an active search for suitable land. Alternatively, he may become aware that a parcel of land is available, then formulate plans for a suitable project for that site meanwhile either knowing or attempting to ascertain that demand for such housing exists (see questionnaire, question II 4). Empirical work\(^5\) has shown that the generalized approach in the development industry consists of periodic searches superimposed upon random contacts made with other agents.

Upon making a tentative decision to go ahead, based largely on intuition, the developer often makes a temporary agreement with the landowner in the form of an option (questions VI 1 to 4) which allows time for investigating the decision before fully committing himself to purchase of the site.

In making his purchase decision, the developer formulates his ideas regarding character and timing of the development in terms of
the economic feasibility and risk involved. His market analysis, based to a considerable extent on experience and intuition, can be supplemented by information about his local market from local planning commissions, zoning boards, mortgage companies, newspapers and private business sources. In addition, much regional and national information concerning business, housing and population is available from the government - population growth and regional redistribution, family formulation, family size, existing housing stock, level of construction, occupations and income of potential buyers (questions III 9 to 12).

The developer's economic feasibility study evaluates the profitability of the proposal in terms of its cost implications (land costs, estimated physical development costs, overhead and financing) and its revenue implications (usually an intuitive estimate of the likely selling price) and is tempered by consideration of investment risks. Of the risks mentioned in interviews by Kaiser and Weiss 6, the most important are:

1. Risk associated with calculation of marketability especially in light of the typically weak analysis of market demand and proper composition of the residential package components of house, site, neighborhood and location.
2. Risks associated with holding of land inventory - the risk of not being able to find suitable land when needed and the risk of having changes in price of land and in consumer preferences while the land is being held.

3. Risks associated with local government such as lengthy delays in obtaining approvals or changes in zoning and subdivision regulations, in timing of installation of public capital improvements, among others.

4. Risks associated with obtaining the necessary approval of financial intermediaries.

Certainly the developer will take steps to minimize his perceived risks. He will select sites with characteristics which he feels are likely to increase the marketability of his product - those seen as having a high social prestige level (the most important as determined by Kaiser and Weiss\(^7\)) and those with institutional characteristics such as availability of urban services, zoning protection, and schools.

The developer is likely to optimize the size of his land inventory within the limits of his perceived risks. "Most developers purchased land for a short-term inventory of suitable land to meet specific markets rather than for long-term speculation of land values."\(^8\) (questions I 11 and 12).
In order to minimize financial risks, the developer is likely to make conservative decisions about the style, type and location in order to avoid risking disapproval of inherently conservative financial intermediaries since their services are required first for development and later for homebuying. In addition, vague and changeable policies concerning annexation, school district boundaries, extension of public utilities, enforcement of subdivision and zoning regulations, building codes, taxation and assessment practices can increase the developer's risks thereby discouraging anything but the most conservative type of development and possibly encouraging scatteration.

The Householder's Decision

The demographic characteristics of household size, place of work, stage in the family life cycle, income level, and activity patterns govern the householder's preferences for space, facilities and accessibility. The attitudinal characteristics of social mobility aspirations, actual mobility and life style govern the livability and prestige preferences. These factors come to bear on the marketability of the final residential package which consists of not only the original
physical, locational and institutional characteristics of the site as modified by the developer but also the dwelling unit itself and other on-site improvements. Further, the residential package must be considered in the context of the social and physical neighborhood created by the development process and the types of households selecting or already occupying other residential packages nearby.

Models of the Development Process

In a "System of Limited Models for Forecasting Urban Residential Growth", R. W. Massie constructed three decision agent models - landowner, developer, and consumer. The output is a spatial distribution of land likely to be sold, a spatial distribution of land likely to be developed, a spatial distribution of subdivision types and an associated distribution of consumer types among the various types of subdivisions.

The landowner model correctly predicted 72.3 per cent of properties sold from these variables:

1. Residence (whether or not the owner resides on the land)
2. Occupation (whether retired or not)
3. Ownership type (single or joint)
4. Length of time the property has been held
5. Amount of contiguous urban development

The producer model correctly predicted 61.5 per cent of the subdivision types (better than the combined landowner-producer model) from these variables:

1. Socioeconomic rank
2. Availability of utilities and services
3. Distance to elementary schools
4. Access to employment areas
5. Distance to the CBD.

The consumer model correctly predicted only 41.7 per cent of the residential packages selected from these variables:

1. Income
2. Education
3. Age
4. Household Size

From interviews of rental developers, Eldridge ranks location factors in the following order:

1. Zoning
2. Financial considerations
3. Market demand
4. Availability of water and sewage
5. "Good" neighborhood
6. Size of parcel
7. Accessibility to work areas
8. Accessibility to commercial facilities
9. Accessibility to schools
10. Topography
11. Soil conditions
12. Location of rental developer's other apartment projects
13. Location of other developers' apartment projects

Analysis of the data demonstrates that rental developers of different scales and of different cities exhibit similarities in their evaluation of decision factors.

In a survey of large and small developers constructing low, medium and high priced subdivisions, Kaiser determines relative associations with certain site characteristics:

Physical characteristics:
- proportion of marginal land;
- proportion of poor soil;

Locational characteristics:
- socioeconomic rank;
distance to nearest major street;
distance to nearest elementary school;
distance to CBD;
inverse of accessibility to employment areas;
amount of contiguous residential development;
amount of recent contiguous residential development;

Institutional characteristics:
availability of public utilities;
zoning protection.

"Developer characteristics, such as size of firm, entrepreneurial approach, and nature of the production process used, influence locational behavior under similar property and contextual factors by affecting the relative attraction of different kinds of sites. In our empirical tests and modeling efforts, we have found significant differences between the locational decisions of large-scale developers (those developing over 100 lots per year) and the locational behavior of small-scale developers. ... Further, the two categories almost appear to be looking for very different combinations of site characteristics. For example, large developers tend to choose sites closer to the CBD, an elementary school, and employment centers, with public utilities available. Small developers tend to select the opposite kind of site."15

"Large scale developers appear much more sensitive than smaller scale developers to accessibility, to availability of water and sewer, and to zoning protection at all levels of subdivision."16
The Housing Market

This section deals with factors in the housing market relating to aggregate supply and demand. Discussion is made of the relationships between fluctuations in housing demand and income of the household, rent levels and the price of housing, and credit availability. Also, investigation is made into the relationship between the volume of residential construction and such factors as interest rates, vacancy levels, and certain aspects of household formation.

Definition of Housing Demand

It is useful at the outset of a discussion of housing demand to note a few definitional points made by W. F. Smith. The distinction between housing "need" and "effective demand" is that the former represents a social value judgement of what ought to be while the latter deals with marketplace demand formed by purchases made by consumers with both the desire and economic means.

The distinction between "stock demand" and "incremental demand" deals with demand for housing in total (which is met from existing stock plus new construction) as opposed to demand simply for new housing. The latter is attractive from
the point of view of facility of analysis but neglects aspects of conversions, filtering, and demolition plus the interrelationships between these factors, existing stock and new construction.

Housing demand is affected by decisions made by both the user and the investor. The investor's decisions will differ from those of the user according to the degree of variance between his assumptions concerning the behavior of housing users and their actual behavior and to the extent that business factors enter into these decisions.

Factors Affecting Housing Demand

1. Demographics

As L. B. Smith points out, demographics involve a large number of factors which affect housing demand in a highly complex manner. Population growth can be disaggregated into age components, family size and social groups which are affected by trends in family formation and dissolution, migration, the number of children per family, the age of parents at the time of their first child, and so on. Further, it is net non-family households (young single persons, middle aged or older widows, widowers, bachelors, spinsters
and divorcees) which tend to generate demand for rental accommodations while families with children which form the majority of demand for owner-occupied housing. For a good analysis of demographics relating to housing, see McAllister.19

2. Income

An increase in the number of single family homes desired results from a rise in income levels by enabling more families to accumulate savings for downpayments and to afford the monthly payments required for home ownership. Rising incomes also stimulate demand for rental accommodation by facilitating family undoubling and non-family formation while raising the quality of accommodations desired. Estimates of stock demand elasticity for dwelling accommodations vary from highs of 1.5 to 2.0 by Reid20 and 1.0 by Muth21 (the consensus being that these results are biased upward) to lows of 0.5 to 0.8 by Lee22, Oksanen,23 Uhler,24 and L.B. Smith.25 That is, the results of studies in both Canada and the U.S.A. show that the proportion of permanent income (and current income) spent on housing decreases as income increases.
3. Prices and Rents

As is the case for changes in prices of other expenditures, relative changes in rents, prices of housing and of non-shelter items bring about substitution effects - rising rents increase demand for owner-occupied (usually single family) housing and non-shelter items; rising prices of single family housing increase demand for rental accommodation and non-shelter items. What is considered to be most relevant in the housing purchase decision is not the purchase price but the size of the downpayment and the monthly interest and principal payment. The multitude of variations and conditions in housing purchases has caused considerable difficulty in reaching agreement concerning price elasticities. L. B. Smith's opinion is that it is about -1.0 through consideration of the variation resulting from the work of Reid (-0.96 to -2.45), Muth (-1.0 to -1.5), Lee (-1.48) and Chung (-1.0).

4. Credit Variables

The demand for owner-occupied dwellings is very sensitive to credit variables, i.e., to changes in the size of the required downpayment and monthly payments (a function of interest rates
and the amortization period). Larger downpayment requirements reduce the number of families with sufficient liquid savings to enter the housing market and reduce the size of housing expenditure that these savings will support. Requirements for larger monthly payments limit the number of families capable of making these payments out of current income.

Credit variables indirectly affect the demand for rental accommodation. That is, when credit terms for single family housing are too onerous demand shifts from owner-occupied to rental accommodation. An offsetting effect, however, is produced by higher rents resulting from reduced multiple family housing construction which is a consequence of the tight money conditions.

5. Other Variables

Expectations regarding land prices, construction costs, credit restrictions, rent levels and plans affecting transportation facilities, zoning and servicing all have a considerable effect upon the demand for housing. Anticipation of tougher times ahead will provide impetus for people to opt for housing today, if possible, thereby shifting future demand into the present.
Factors Affecting Housing Supply

The extremely complex area of housing supply deserving much attention has had little, (for a summary, see Winger\textsuperscript{31}). Some of the factors affecting the volume and location of redevelopment of the central city (especially those concerning apartment development) are discussed by L.S. Bourne\textsuperscript{32}. In an extensive investigation into the process of apartment development through a survey of developers, W. F. Smith\textsuperscript{33} isolates three factors which "explain" the increase in apartment construction in the sixties:

1. A demographic shift favoring households in the predominantly renter ages;
2. An increase in the availability of mortgage funds coupled with a competitive struggle for high-yield loans;
3. Income tax provisions favorable to investment in multi-family dwellings (which may have changed in Canada as a result of changes in the Income Tax Act in 1972 which placed a curb on pooling of income).

At the beginning of this review, reference was made to the factors affecting producer behavior in the housing field. Some of the more important constraints within which the developer
operates are: the requirement of anticipating the type, location, price range, quality, size, and magnitude of consumer demand; zoning, municipal bylaws, building codes, delays in obtaining governmental approval and manoeuvring by political and citizens' groups; financial constraints, changes and trends in the availability of financing and interest rates, rising construction costs (both labor and materials), and delays due to labor disputes.

Models of the Housing Market

Analytical work on the determinants of residential construction can be divided broadly into two types: 34

1. Models based primarily on a verbal or qualitative analysis of the market:

   Analysed on the basis of available statistics and ad hoc judgements, they place stress on variables relating construction specifically to housing market conditions and factors external to the housing market and attempt to identify secular trends, long swings and short cycles in residential construction.

2. Statistical models which relate various economic indices to quantitative changes in the volume of construction and various time leads and lags:
Typical are time series analyses of such variables as income, rents and costs, household formation and existing housing stock. For a bibliography of some earlier models, see Grebler and Maisel. 35

An important analysis of Maisel 36 involves relating census type housing starts to the Treasury Bill rate, the residential cost component of the consumer price index, the variation in the trend in vacancies, and an estimate of removals and net household formation for the period. In achieving very good results he concludes that housing stability is dependent upon the federal (U.S.) government actions dampening rather than reinforcing the residential cycle.

Muth's study 37 is concerned with the response of housing demand to changes in price and income and with the rate at which adjustments of the housing stock take place. His evidence indicates that new construction is highly responsive to changes in income and the price of housing, the elasticities of new construction with respect to price and income both being about 5.5. Muth identifies two
lags of adjustment of the housing stock: the lag of adjustment of actual to desired stock due to slowness of families to make the housing decision; and the lag of adjustment of desired stock to current income due to the lag of current income behind expected or normal income (Freidman).

W. F. Smith's \textsuperscript{38} "simplistic model" of housing demand determines the range of requirements (both quantitative and qualitative) for housing within the context of many factors: vacancies; "suppressed demand" (a societal judgement); demolitions; unintended vacancies (from preexisting stock that have not yet been demolished); absorption rates of new construction; differentiation of the housing stock according to economic factors and preferences of demographic groups; and growth and change of composition of households over time.

A simplified model of housing demand is that of Leo Klaassen\textsuperscript{39} which utilizes factors underlying the development of the housing sector which are identifiable as those causing general economic development. Very general explanations for housing market development are used - income growth and distribution, population growth, income elasticity of housing
demand and depreciation of the housing supply. As pointed out by U. Wullkopf,40 problems with time and spatial distribution as well as filtering remain.

L. B. Smith,41 in obtaining his econometric results, utilizes two models of the Canadian housing market: an aggregate and a disaggregate version of a short-run supply model; and an adaptation of a long-run stock adjustment model.

In the short-run model, family demand for housing accommodations is thought of as a function of permanent real family disposable income, the price of housing, the prices of alternative goods and services and the cost and availability of mortgages. The disaggregate version is modified to incorporate rental versus owner-occupied housing, and single versus multiple family housing. From this general housing model he concludes:

1. Housing starts are very sensitive to both the cost and availability of mortgage credit (the elasticity of total housing starts to variations in the mortgage rate being -0.80 and to variation in the bond rate being -0.37).

2. Credit rationing operates more strongly upon single family housing starts.
3. Housing starts are very sensitive to the volume of government direct lending.

4. The volume of housing starts is highly dependent on the relationships between prices, rents and construction costs.

5. Land costs play an important role in determining the mix of single and multiple family housing starts.

Smith's stock adjustment model (which assumes equilibrium of supply and demand) determines the per family excess demand as a function of per family real disposable income, the price of new housing relative to prices of alternative goods and services, the cost of mortgage credit, the availability of private mortgage credit (the spread between yields on bonds and mortgages), and the volume of CMHC lending. From this stock adjustment model he concludes that housing stock has an average speed of adjustment of approximately 0.23. This means that it takes roughly two and three-quarter years for construction to eliminate half the gap between the desired and actual housing stock.
Comment

The models presented above are all macro models dealing with the national economy and as such are limited in their scope from analysis of factors and examination of policy alternatives concerning the regional housing market.

Disaggregation of demand according to different household types, age groupings and accompanying housing preferences has not been made. Consideration of a wide scope of alternative forms of housing, communal facilities and accompanying life styles, which is one of the areas of investigation with most potential, could thereby be made possible.
Models Concerned with Housing Patterns in General Terms

This section is concerned with potentially operational models which are generalized explanations of the land use patterns of cities. The problem formulation centres on the distribution of housing units among a number of small areas into which the urban region has been divided. The handling of the redistribution of households is avoided due to the difficulty of detecting the volume and direction of redistribution and the subtlety of factors involved.

Burgess' Concentric Zone Theory

In order to explain the effect of market forces upon land use and to thereby understand the processes of expansion of urban areas, Burgess conceived the city as a series of five concentric zones. At the core is the central business district. Encircling the core is an area in transition - an older warehouse and market district which is evolving into an area of business and light manufacture. A third zone is that inhabited by industrial workers who have escaped from the deteriorating area of transition but who desire to live within easy
access of their work. Beyond this zone is the residential area of high-class apartment buildings or of exclusive "restricted" districts of single family dwellings. Still farther out, beyond the city limits is the commuters' zone - suburban areas or satellite cities - within a thirty to sixty minute ride of the central business district.

Depending upon the rate of economic expansion and population growth in the city, each zone tends to invade the next outer zone. In addition there are centrifugal forces causing certain functions in the central zone of the city to migrate to outer zones as well as centripetal forces which hold certain other functions in the central zone and attract still others to it. 43

Hoyt's Sector Theory

Homer Hoyt's refined theory of axial development 44 postulates that growth of similar types of land use usually occurs along an axis of transportation. The various areas of a city are envisaged as wedge-shaped sectors radiating out from the central core. Areas of similar types of land use originate near the centre and expand outward at the periphery.

Theory of Multiple Nuclei

Harris and Ullman 45 observed that
frequently the land use pattern is built not around a single centre as in Burgess' and Hoyt's models but around several discrete nuclei. These nuclei, which may vary in number in different cities, often have a specialized function. Typically there is a central business district, a wholesale and light manufacturing district, several residential districts, and minor nuclei or foci of various forms of subordinate activity. They may result from a combination of factors; the interdependency of certain types of activities; the requirement of certain activities for specialized facilities; the repelling forces between certain unlike activities; and economic forces surrounding high rents of the most desirable areas.

Clark's Theory of Exponentially Declining Densities

The evidence gathered by Clark in the detailed study of density maps of numerous cities in the world shows that in practically every case, the progressive decline in density from the central business district to the outer suburbs is a simple exponential:

\[ y = Ae^{-bd} \]

where \( y \) is the density of the resident population and \( d \) is the distance from the centre of the city.
Further, he showed that in most (but not all) cases, the city tends to spread itself out over time — density tends to fall in the most populous inner suburbs and to rise in the outer suburbs — adhering to an exponential decline with different values for the coefficients $A$ and $b$.

Models Involving Transportation Costs and Spatial Preferences

The models presented above describe observable spatial patterns of urban development. They offer little to the understanding of processes leading to that development. The following models introduce behavioral decision making into a general economic framework in trying to simulate real world processes. Each decision-making unit chooses the "best" alternative for itself from the choices available.

1. Kain's Model

Kain's central hypothesis is that households substitute journey-to-work expenditures for site expenditures. This substitution depends primarily on household preferences for low-density as opposed to high-density residential areas. The model predicts that households will locate at
varying distances from their workplaces according to their transportation costs, space consumption, spatial preferences and incomes. Differences in the length of the journey-to-work and in the locational choices of workers employed in each area are a function of location rents which, typically, tend to decrease asymptotically with distance from the central business district. The result of empirical tests is a series of concentric rings - similar to those of Burgess - identifiable in terms of differing residential densities, family size, space consumption, occupational and income differences, and length of the journey to work.

2. Alonso's Model

Alonso's economic analysis of the urban land market is embedded in a mathematical model which focuses on the interaction of urban land rents, interurban locational processes and the intensity of use (density of occupancy) of urban space. In the land market there are two goods (land and distance) but only one transaction and one price (that of land) leading to a complication of simple supply and demand equilibrium. Here he has, in effect, condensed the five dimensional problem of utility, land, distance, composite goods and money. An equilibrium solution to the
land market is obtained through determination of the location and size of sites occupied by residents, urban firms, and agriculture through the use of bid price curves (for residents and firms) and bid rent curves (for agriculture).

3. Wingo's Model

Wingo's interpretation of the relation between transportation and urban land use involves four general aspects of the city: physical characteristics of urban space; population of a specified composition; aspects of technology which permit movement of this population in the urban space; and the organization of society to produce and consume goods and services. He incorporates in his model a concept of transportation demand; a description of the transportation function in terms of technology and demand; a transport cost function based on time, distance, and overhead; a system of location rents based on the transport cost function; and implications of the supply of space and household demand for space. The result is a spatial distribution of location rents and household densities involving both policy and structural effects of the market in the context of the urban economy.
Comment

In contrasting his work directly with that of Kain, Stegman attacks the preeminence of accessibility in the residential location decision which has been at the basis of the last three models. The results of his survey of moves in major metropolitan areas reveal that the majority of changes in residence were not work-related, and that such factors as space, housing quality, home ownership, neighborhood quality were of more importance. Moreover, in response to a question relating the two factors, 83 per cent of suburban movers chose the more desirable rather than the more accessible neighborhood. The direction suggested by this work is toward a microlevel of household decision-making rather than the general macrolevel view of urban residential growth of the models presented above.
Models of Residential Location

Ad Hoc Allocations

An ad hoc system for allocating new dwelling units described by Chapin\textsuperscript{51} involves calculation of the residential "holding capacity" for each of the subareas followed by allocation of the estimated total of new households. Both steps require intuitive and objective judgements about how the city is likely to grow coupled with such information as prevailing densities, zoning and density standards, the amount of vacant and renewable land, and population-income breakdown.

The CATS model

The model used by the Chicago Area Transportation Study\textsuperscript{52} for forecasting land uses imposes subjective elements of judgement over a formal structure of hypothecated growth processes. Base year occupancy patterns (existing land use, population density and employment), zoning and plans for redevelopment are modified by judgement to calculate holding capacity of each zone. Forecasts for the target year of total population and of employment
by industry type are distributed in a continuous function over concentric zones resulting from consideration of the distance of the subareas from the central business district and the percentage of capacity that the present population represents. In this technique, the urban growth process is envisaged essentially as an increase in densities in a pattern of concentric zones surrounding an inner zone in which densities decline. However, this model, like that of Chapin, does little to enlarge understanding of the spatial organization of the city and aids little in evaluating the impacts of alternative public policies.

The U.N.C. Model of Land Use Succession

The model of Donnelly, Chapin and Weiss of the University of North Carolina is designed to predict the incidence of conversion of rural or vacant land to residential use as population of the urban area increases. The approach involves a ranking of private and public decisions and/or actions. Thus, "priming actions" are those of major significance in the urban environment such as the construction of an expressway or large industrial plant; "secondary actions" are generally more individualistic, more numerous and comprise the bulk of the visible pattern of land development. The location and density of secondary actions are felt to be predetermined by priming actions.
A standard linear multiple regression analysis is used to determine those factors which "explain" dwelling density and the amount of land in residential use. The four priming factors which were determined were: accessibility to work areas; availability of public sewerage; accessibility to nearest major street; and accessibility to nearest available public school.

The functioning of the model involves five steps:

1. The inventory of undeveloped land is determined and coded for use capability;
2. A measure of "relative value" based on land values is assigned to each site;
3. The effect of priming actions anticipated during the forecast period is determined from linear regression coefficients and is used to modify the relative value of land for residential use;
4. Density and housing-value constraints are introduced and the land "reassessed" to obtain a measure of the total attractiveness of undeveloped areas for residential use;
5. New housing anticipated during the growth period is allocated on a probabilistic basis.
"The study presently concentrates on the growth areas and new residential development, leaving the handling of decrease areas and renewal processes ... to be dealt with in later extensions of this research".54

Like the CATS model, the U.N.C. model does not comment directly on the origins or destinations of movers. Despite the U.N.C. group's extensive investigation into behavior of land developers, it is not reflected in the formal structure of the model.

Harris' Stochastic Model of Urban Development

Harris's55 attempt to model the uncertainty of direction and timing of suburban growth is a restricted form of a stochastic process in which the results are expressed as probabilities of subareas in the urban fringe becoming urbanized in a given time period. The process of suburban development is stochastic in that in moving from one state of development to another the probability of entering a certain state depends only on the last state occupied. A theory which specifies the causation and interrelationships between all the many complex variables and determinants of the rate
and direction of suburban growth is beyond reach of the present state of knowledge. However, the stochastic process model summarizes the results of these determining variables and offers a framework in which limited knowledge of the process of suburban growth can be put to use.

Hill's EMPIRIC model

The Empiric land use model (Hill) is designed to reallocate projected regional growths in population and employment in urban subareas. A set of simultaneous equations relates predicted changes in the distribution of population and employment in the subareas to one another, to the initial year base distribution, zoning, intensities of land use, transit accessibilities, and water and sewage services, and to the estimated effects of planning policy decisions. The planning policy decisions may be expressed as estimated changes in regional accessibility which is a function of transportation improvements, exogenously specified residential, commercial or industrial development, or subareal growth constraints. As such, the model is useful both as a forecasting tool as well as mechanism for evaluating the impact of major
policy decisions on the future distribution of regional population and employment. The model does not comment on the interdistrict flows necessary to produce the net changes resulting from the solution of the equations nor is any reference made to land use succession.

The Lowry Model

Lowry\textsuperscript{57} has proposed an urban development model which focuses on the interrelationships between three broad areas of activity: basic sector employment, service sector employment, and the household sector. A distribution of basis employment in the various zones (grid squares) is specified exogenously and the households of the workers in the basic employment sector are then allocated to residential zones around the basic workplaces by a residential location submodel. The demand for services generated by this basic population supports locally dependent service centres which are located by a second spatial allocation submodel. The workers in this service employment are allocated housing locations and the process is reiterated until the system stabilizes.
The Steger 58 revision of the Lowry model makes it a more complete predictor of urban development allowing the relocation of basic industries within the context of the city. Secondly, rather than distribute all activity in one shot, it predicts incrementally the location and relocation of new and existing households and businesses from the pattern of previous development. Rather than reflect Lowry's equilibrium state of the metropolis, the model is sensitive to policy assumptions and is thereby useful in the measurement and prediction of the cumulative effects of urban renewal decisions over time.

Bay Area Simulation Study (BASS)

The Lowry model was the stimulus for BASS which had as its primary purpose the measurement of the impact of industrial location. It generated employees, population, and households for each census tract (rather than households for each grid square) and disaggregated many parameters which were applicable to the whole system in the Lowry model to individual tract-specific form.

The BASS residential location sub-model59 matches the supply of housing and of
usable land with exogeneously determined housing demand for the six categories of housing (two types of housing, three income classes). The supply of housing results from consideration of filtration (estimated shifts in inventory of the six housing categories) and the supply of usable land (estimated as a function of the existing housing in each housing category as well as the density of development). In each iteration of the model, about thirty per cent of new construction is located according to accessibility to the location of new employment. However, allocation of existing demand for the six categories of housing to the individual subareas is made on the basis of the relative accessibility of each area to existing employment.

Although there are no explicit policy variables in the model, they can be introduced implicitly through changes in the input assumptions (regarding availability of usable land) and in locational and behavioral functioning.

Projective Land Use Model (PLUM)

Further in the line of development that grew out of experiments with BASS, the PLUM Model was implemented to forecast the population,
dwelling units, and employment used by the Bay Area Transportation Study Commission. Among the more important additional concepts which were incorporated is the handling of travel. The model simulates trips rather than estimating them in correspondence to an accessibility index. Trips were disaggregated by type (work-to-home, work-to-shop, and home-to-shop) and spatially by county. Network times were created by generation of minimum time paths with alternatives for free-flow and peak-hour versions.

Herbert and Stevens' Model of Market Demand

Herbert and Stevens' linear programming model is designed to distribute households to residential land in an optimal configuration. Over a number of short iterative time periods, the model optimizes savings in the household's selection of a residential bundle (house, amenity level, trip set and site size) with respect to all previously located activities. Land is allocated to that group of households which can bid the highest price for it. In the Penn-Jersey Transportation Study which has the same theoretical framework, the changing character and
income of households over time is reflected in the aging of households in each zone. The major difficulty in a linear programming approach to modelling household demand is that demand behavior is fundamentally nonlinear in nature and certain important features of consumer behavior cannot be incorporated in the analysis.

A. D. Little (San Francisco) Model of Market Supply

Developed by A. D. Little, Inc. for the San Francisco Planning Commission, this model\textsuperscript{63} was designed for use in urban renewal planning in that it is a micro-analysis of the decision-making processes which lead to changes of occupancy and the state of housing stock. The model attempts to simulate the location decisions of different users of space, the investment behavior of private investors and the impacts of public policies and actions. The existing housing stock in each subarea or "fract" is classified by use, condition, and location and is "aged" probabilistically over time to a lower condition. A notable feature of this model is the absence of any transportation or accessibility considerations.
The model considers only part of the relevant urban system - the housing market - ignoring for example the possibility of demolition of residential units to permit the construction of a commercial unit. The model recognizes that housing units can age and change condition. Households, however, do not, as contrasted with the Sears's model.

Sears' Model

Sears' New York State Regional Housing Model\textsuperscript{64} is essentially an equilibrium model which assumes that supply varies directly with demand. It may also be seen as a "double cohort survival" model in which both households and housing units go through an aging process. Total active demand in each subarea is the sum of three components:

1. households without housing due to aging (of households or housing);
2. households without housing due to dissatisfaction;
3. additional households.

Total active supply in each subarea is the sum of the following three parts:

1. housing vacant due to aging (of
households or housing);
2. housing vacant due to dissatisfaction;
3. additional housing.

The model is predictive in that its use, together with sensitivity analysis, may aid in evaluating the impact of alternative government housing policies on the housing situation.

Discussion of the Models of Residential Location

1. Contextual

Most of the models presented here were developed within the greater context of regional economic or transportation studies. In order to adequately represent the development process they must do more - they must operate in the framework of industrial location and relocation, consumer and producer behavior and changing transportation technology.

2. Forecasting the Effects of Public Policies

Only the Empiric and A. D. Little models explicitly allow for the evaluation of alternative public planning policies although in the BASS and Sears models they may be implicitly incorporated. All the models were developed in
the U.S.A. where the institutional and political conditions affecting urban development are substantially different from the Canadian.

3. Market Equilibrium and Disaggregation

In all but the A. D. Little model, total supply of housing is simply equated to total demand for housing - the condition for continuous equilibrium. There is no distinction made between the factors affecting location, type and quantity of housing demanded and supplied. Therefore, interactions between the two, and long range instability in the housing market must be ignored. Also, there is no differentiation of preferences of housing type, location and form of tenancy according to different household subgroups classified by age, family structure, social status and income.

In incorporating the investment behavior of private investors, the A. D. Little model handles market disequilibrium through the price mechanism. Demand (specified exogenously) dictates price levels of existing housing and the degree of crowding in the city while the new supply is based on profitability of investment determined by those price levels.
4. Locational Criteria

The locational emphasis in these models has been on accessibility to employment, sewerage, major transportation routes, etc. The neighborhood considerations shown to be important by Stegman\(^6^5\) and the locational factors affecting entrepreneurial behavior on the part of the developers reported by the U.N.C. group have yet to be properly incorporated in a model.

5. Spatial Disaggregation

Only two of the models (Herbert and Stevens and A. D. Little) are spatially disaggregated through consideration of competition among different types of households for the available location. The other models, with the exception of the Sears' model which has no spatial disaggregation, distribute total demand to available housing in the given subareas in proportion to weights which the model calculates. For example, in the Lowry case accessibility to employment is the key. The U.N.C. model measures developmental attractiveness in terms of land prices, accessibility to employment, schools, major transportation routes, and public sewerage.
The Herbert and Stevens' model matches spatially disaggregated supply to demand on the bases of the consumer's ability to pay for housing within the context of his other needs and the level of his income. In the A. D. Little model, housing units are allocated on the basis of user groups' preferences for type and location.

6. Intra-regional Mobility

All but two of the models assign households to a subarea and fix them there for all time, ignoring the mobility of households within the urban area. This necessitates the assignment of new households to new housing, ignores the aging process of households and of houses, and avoids consideration of movement between rental and owner-occupied housing. The A. D. Little model attempts to account for this by reallocating households to housing every two years. Only the Sears' model properly accounts for changes in supply and demand due to dissatisfaction, aging and new additions of houses and households.

7. Aspects of Renewal and Redevelopment

Although most models account for changes in existing housing stock resulting from
demolitions, conversions and filtering by way of changes in density of use, only in three models (A.D. Little, BASS and Sears) are these factors explicitly considered. One of the central features of the A.D. Little model is redevelopment behavior of entrepreneurs and the public. In the BASS model, demolitions and filtering are considered in a separate submodel. Aging of houses is one of the main features of the Sears model although it is limited by the lack of spatial disaggregation. For an interesting analysis of this subject (including intra-regional moves, absorption of new housing, vacancy rates and rent levels), see Mittelbach.
Scope and Methodology

Two Approaches

It is the intent of this study to provide a means whereby the spatial distribution of housing units in the Vancouver Metropolitan Area can be explained.

The analysis is to involve two approaches: The first approach involves a ranking of weighting factors for each subarea which would sum to a relative "measure of attractiveness from a developmental point of view". The results of interviews with developers in the form of a questionnaire yields a rough guide as to the importance of proposed locational decision factors.

Those factors which are ranked of average or greater than average importance are considered to be potential determinants in the location of new housing. In order to ascertain the degree of importance of each factor it is intended to regress these factors against unit completions of single family detached housing, single family attached housing and apartment housing. The regression coefficients are intended to provide weights which, when applied to the characteristics of each subarea, provide a ranking of developmental attractiveness.
The second approach is based upon Clark's Theory of Exponentially Declining Densities. The 1961, 1966 and 1971 population densities of the 1961 Census Tracts are analysed in terms of distance from the central business district (Georgia Street and Granville Street). In those subareas where density is less than that determined by the theory, development is expected to take place. That is, the difference between calculated and observed densities is a measure of the unused housing potential. And in order to ascertain its importance as a predictor variable, total housing unit completions are regressed against the unused housing potential.

It is intended that the two approaches complement one another. That is, the potential approach (dealing with total housing completions) is to provide support for the conclusions obtained by the behavioral approach (dealing with completions of single family and multiple family housing).

Data Gathering Technique

The analysis of this study is based upon data obtained through interviews with sixty-three companies involved in residential development in the Greater Vancouver Area.
The list of developers to be contacted was compiled from

(a) the membership list of the Greater Vancouver Real Estate Board (the most useful);

(b) the local membership list of H.U.D.A.C. (The Housing and Urban Development Association of Canada);

(c) "Contacts Influential Vancouver 1971" - a compilation of all firms in Vancouver by industry type (firms under the industry "Real Estate" were contacted).

The resulting number of developers to be contacted was approximately one hundred and ninety. About forty were simply contractors or real estate sales offices which had little to do with the location decision making and therefore were not interviewed. About twenty had gone out of business or were no longer involved in housing development. About thirty were involved only in commercial and industrial development. About twenty-two were continually unavailable because they were too busy, always travelling or uncooperative. About fifteen were very small developers of single family dwellings (which were felt to be already sufficiently represented in the sample.)
Typically, the interviews comprised approximately one-half hour for responses to questions read by the interviewer (see questionnaire, Appendix A) followed by approximately one-quarter hour discussion of various aspects of the housing market raised by the questionnaire.

Limitations of the Questionnaire Approach

The problems facing data collection by means of a questionnaire during an interview are:

1. the necessity for anticipating the eventual results of the survey in order to include sufficient variables that relevant factors are not overlooked;
2. the necessity for phrasing the questions in such a manner that the intent of each question is not misinterpreted;
3. the necessity for inclusion of questions relevant to all types of developers, while avoiding different interpretations due to differences in operation;
4. the difficulty for developers, who typically are unused to articulating such abstractions, to isolate the relevant factors from the immense complexity of their environment;
5. the necessity for the interviewer to resist temptation to assist the respondent in making his response;

6. the possibility that the developer is so immersed in his particular situation that he cannot see the general context of the environment in which he works. He may, for example, develop in an area where the holding qualities of the soil are good so that in his limited context this factor is relatively unimportant in his location decision;

7. the possibility of reluctance on the part of some developers to release certain information (although this was not felt generally to be the case); in contrast, there may have been some desire to convey the "proper" image by responding according to what was expected or was felt ought to be done.

Limitations of the Questionnaire

One of the major limitations of the questionnaire used to gather data for this study is that responses of developers of more than one type of housing are not disaggregated by type. That is, responses to the questions relating to location decision factors (among others) ought to have been obtained for each of the housing types developed.
In addition respondents indicated that their responses would vary according to the market catered to by particular projects. In readministering the questionnaire, responses ought to be obtained according to the socio-economic class to which appeal is made.

The Sample

The results of this questionnaire were taken from interviews with sixty-three developers of multi-family housing, single family housing, and subdividers. Numbers of developers of each housing type were grouped by the average number of units constructed during each of the last three years. (total units constructed during the three years divided by three).

Multi-Family Housing:

<table>
<thead>
<tr>
<th>Units Constructed</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 50</td>
<td>11</td>
</tr>
<tr>
<td>51 - 100</td>
<td>3</td>
</tr>
<tr>
<td>100 - 150</td>
<td>5</td>
</tr>
<tr>
<td>151 - 200</td>
<td>5</td>
</tr>
<tr>
<td>Greater than 200</td>
<td>5</td>
</tr>
<tr>
<td>Statistics not Available</td>
<td>6</td>
</tr>
<tr>
<td>Total:</td>
<td>35</td>
</tr>
</tbody>
</table>
The multiple family housing units completed by our sample compared to the total completions as reported by "Real Estate Trends in Metropolitan Vancouver, 1972-3" (page B-16) are:

<table>
<thead>
<tr>
<th>Units Completed By Sample</th>
<th>Total Units Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>4329</td>
</tr>
<tr>
<td>1971</td>
<td>3332</td>
</tr>
<tr>
<td>1970</td>
<td>2834</td>
</tr>
</tbody>
</table>

* twice the completions of the first six months of 1972

Single Family Housing:

| 1 - 15 | 11 |
| 16 - 35 | 10 |
| 36 - 75 | 8 |
| 76 - 150 | 5 |
| Greater than 150 | 1 |
| Statistics not Available | 6 |
| Total: | 41 |

The single family housing units completed by our sample compared to the total completions as reported by "Real Estate Trends in Metropolitan Vancouver, 1972-3" (page A-8) are:
<table>
<thead>
<tr>
<th>Year</th>
<th>Units Completed By Sample</th>
<th>Total Units Completed</th>
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</thead>
<tbody>
<tr>
<td>1972</td>
<td>2132</td>
<td>5242 *</td>
</tr>
<tr>
<td>1971</td>
<td>1373</td>
<td>5216</td>
</tr>
<tr>
<td>1970</td>
<td>1035</td>
<td>4365</td>
</tr>
</tbody>
</table>

* twice the completions of the first six months of 1972

Subdividers:

<table>
<thead>
<tr>
<th>Subdividers</th>
<th>Lots Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 15</td>
<td>7</td>
</tr>
<tr>
<td>16 - 35</td>
<td>3</td>
</tr>
<tr>
<td>36 - 75</td>
<td>3</td>
</tr>
<tr>
<td>76 - 150</td>
<td>2</td>
</tr>
<tr>
<td>Greater than 150</td>
<td>2</td>
</tr>
<tr>
<td>Statistics not Available</td>
<td>6</td>
</tr>
</tbody>
</table>

Total: 21

The number of lots subdivided by those in our sample were:

<table>
<thead>
<tr>
<th>Year</th>
<th>Lots Subdivided by Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>2204</td>
</tr>
<tr>
<td>1971</td>
<td>1216</td>
</tr>
<tr>
<td>1970</td>
<td>965</td>
</tr>
</tbody>
</table>

Statistics of total lots subdivided by year were not available for comparison.

This compares to CMHC developer statistics as follows:67
## Builder Activity by Dwelling Unit Range 1970 (Vancouver)

<table>
<thead>
<tr>
<th>Range</th>
<th>Number of Builders</th>
<th>Units Constructed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 25</td>
<td>179</td>
<td>451</td>
</tr>
<tr>
<td>26 - 50</td>
<td>6</td>
<td>161</td>
</tr>
<tr>
<td>51 - 100</td>
<td>3</td>
<td>243</td>
</tr>
<tr>
<td>Greater than 100</td>
<td>5</td>
<td>1045</td>
</tr>
</tbody>
</table>
Empirical Results of the Questionnaire

Tables I, II, III and IV contain the questionnaire results for all developers and for each of the three developer categories. Reported in the tables are those factors which were ranked by all developers together as of average or greater than average importance (2.0 or above).

The two factors ranked highest by all developers showed very little variation of the mean (3.45, 3.49, 3.48 for proper zoning, and 3.34, 3.29, and 3.37 for access to trunk sewer). However, for price of land, the mean of 3.38 for developers of single family housing is significantly above the other two (3.16 and 3.00). This quite possibly results from the heavy bias in the sample towards small scale developers of single family housing who are limited to a greater degree by financial constraints. Availability of developable land was ranked by the three types of developers with very little variation (3.00, 2.91, and 3.04). The low weighting given to nearness to schools by developers of multiple family dwellings (2.16 vs. 2.51 and 2.41)
## TABLE I

Evaluation of Location Factors By All Developers

(Per cent of Respondents in Parentheses)

<table>
<thead>
<tr>
<th>Location Factors</th>
<th>Unimportant (0)</th>
<th>Fairly Important (1)</th>
<th>Average Importance (2)</th>
<th>Very Important (3)</th>
<th>Essential (4)</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper Zoning</td>
<td>3(4.8)</td>
<td>0(0.0)</td>
<td>5(8.1)</td>
<td>16(25.8)</td>
<td>38(61.3)</td>
<td>3.39</td>
<td>1.00</td>
</tr>
<tr>
<td>Access to Trunk Sewer</td>
<td>3(4.8)</td>
<td>2(3.2)</td>
<td>1(1.6)</td>
<td>26(41.9)</td>
<td>30(48.4)</td>
<td>3.26</td>
<td>1.01</td>
</tr>
<tr>
<td>Price of Land</td>
<td>3(4.8)</td>
<td>2(3.2)</td>
<td>5(8.1)</td>
<td>21(33.9)</td>
<td>31(50.0)</td>
<td>3.21</td>
<td>1.06</td>
</tr>
<tr>
<td>Availability of Developable Land</td>
<td>2(3.2)</td>
<td>4(6.4)</td>
<td>11(17.7)</td>
<td>21(33.9)</td>
<td>24(38.7)</td>
<td>2.98</td>
<td>1.06</td>
</tr>
<tr>
<td>Nearness to Schools</td>
<td>6(9.8)</td>
<td>7(11.5)</td>
<td>14(23.0)</td>
<td>29(47.5)</td>
<td>5(8.2)</td>
<td>2.33</td>
<td>1.10</td>
</tr>
<tr>
<td>Nearness to Major Roads</td>
<td>8(12.9)</td>
<td>8(12.9)</td>
<td>16(25.8)</td>
<td>23(37.1)</td>
<td>7(11.3)</td>
<td>2.21</td>
<td>1.20</td>
</tr>
<tr>
<td>Nearness to Major Shopping Areas</td>
<td>7(11.5)</td>
<td>8(13.1)</td>
<td>18(29.5)</td>
<td>25(41.0)</td>
<td>3(4.9)</td>
<td>2.15</td>
<td>1.09</td>
</tr>
<tr>
<td>Size of Site</td>
<td>10(16.4)</td>
<td>9(14.8)</td>
<td>16(26.2)</td>
<td>19(31.1)</td>
<td>7(11.5)</td>
<td>2.07</td>
<td>1.26</td>
</tr>
</tbody>
</table>
### TABLE II

Evaluation of Location Factors
By Developers of Multiple Family Dwellings

(Per cent of Respondents in Parentheses)

<table>
<thead>
<tr>
<th>Location Factors</th>
<th>Unimportant (0)</th>
<th>Fairly Important (1)</th>
<th>Average Importance (2)</th>
<th>Very Important (3)</th>
<th>Essential (4)</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper Zoning</td>
<td>1(2.6)</td>
<td>0(0.0)</td>
<td>3(7.9)</td>
<td>11(29.0)</td>
<td>23(60.5)</td>
<td>3.45</td>
<td>.86</td>
</tr>
<tr>
<td>Access to Trunk Sewer</td>
<td>2(5.3)</td>
<td>1(2.6)</td>
<td>0(0.0)</td>
<td>14(36.8)</td>
<td>21(55.3)</td>
<td>3.34</td>
<td>1.02</td>
</tr>
<tr>
<td>Price of Land</td>
<td>2(5.3)</td>
<td>1(2.6)</td>
<td>4(10.5)</td>
<td>13(34.2)</td>
<td>18(47.4)</td>
<td>3.16</td>
<td>1.08</td>
</tr>
<tr>
<td>Availability of Developable Land</td>
<td>1(2.6)</td>
<td>3(7.9)</td>
<td>8(21.0)</td>
<td>9(23.7)</td>
<td>17(44.7)</td>
<td>3.00</td>
<td>1.12</td>
</tr>
<tr>
<td>Nearness to Schools</td>
<td>6(16.2)</td>
<td>4(10.8)</td>
<td>9(24.3)</td>
<td>14(37.8)</td>
<td>4(10.8)</td>
<td>2.16</td>
<td>1.26</td>
</tr>
<tr>
<td>Nearness to Major Roads</td>
<td>4(10.5)</td>
<td>4(10.5)</td>
<td>9(23.7)</td>
<td>16(42.1)</td>
<td>5(13.2)</td>
<td>2.36</td>
<td>1.17</td>
</tr>
<tr>
<td>Nearness to Major Shopping Areas</td>
<td>5(13.5)</td>
<td>5(13.5)</td>
<td>12(32.4)</td>
<td>13(35.2)</td>
<td>2(5.4)</td>
<td>2.05</td>
<td>1.13</td>
</tr>
<tr>
<td>Size of Site</td>
<td>3(7.9)</td>
<td>5(13.2)</td>
<td>11(29.0)</td>
<td>14(36.8)</td>
<td>5(13.2)</td>
<td>2.34</td>
<td>1.12</td>
</tr>
<tr>
<td>Location Factors</td>
<td>Unimportant (0)</td>
<td>Fairly Important (1)</td>
<td>Average Importance (2)</td>
<td>Very Important (3)</td>
<td>Essential (4)</td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>----------------</td>
<td>---------------------</td>
<td>------------------------</td>
<td>-------------------</td>
<td>---------------</td>
<td>--------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Proper Zoning</td>
<td>2(4.4)</td>
<td>0(0.0)</td>
<td>3(6.7)</td>
<td>9(20.0)</td>
<td>31(68.9)</td>
<td>3.49</td>
<td>0.97</td>
</tr>
<tr>
<td>Access to Trunk Sewer</td>
<td>1(2.2)</td>
<td>1(2.2)</td>
<td>1(2.2)</td>
<td>23(51.1)</td>
<td>19(42.2)</td>
<td>3.29</td>
<td>0.81</td>
</tr>
<tr>
<td>Price of Land</td>
<td>1(2.2)</td>
<td>1(2.2)</td>
<td>3(6.7)</td>
<td>15(33.3)</td>
<td>25(55.6)</td>
<td>3.38</td>
<td>0.89</td>
</tr>
<tr>
<td>Availability of Developable Land</td>
<td>1(2.2)</td>
<td>3(6.7)</td>
<td>9(20.0)</td>
<td>18(40.0)</td>
<td>14(31.1)</td>
<td>2.91</td>
<td>1.00</td>
</tr>
<tr>
<td>Nearness to Schools</td>
<td>3(6.7)</td>
<td>4(8.9)</td>
<td>9(20.0)</td>
<td>25(55.6)</td>
<td>4(8.9)</td>
<td>2.51</td>
<td>1.01</td>
</tr>
<tr>
<td>Nearness to Major Roads</td>
<td>7(15.6)</td>
<td>6(13.3)</td>
<td>12(26.7)</td>
<td>17(37.8)</td>
<td>3(6.7)</td>
<td>2.07</td>
<td>1.19</td>
</tr>
<tr>
<td>Nearness to Major Shopping Areas</td>
<td>4(8.9)</td>
<td>4(8.9)</td>
<td>14(31.1)</td>
<td>21(46.7)</td>
<td>2(46.7)</td>
<td>2.29</td>
<td>1.01</td>
</tr>
<tr>
<td>Size of Site</td>
<td>9(20.5)</td>
<td>7(15.9)</td>
<td>10(22.7)</td>
<td>14(31.8)</td>
<td>4(9.1)</td>
<td>1.93</td>
<td>1.30</td>
</tr>
<tr>
<td>Location Factors</td>
<td>Unimportant (0)</td>
<td>Fairly Important (1)</td>
<td>Average Importance (2)</td>
<td>Very Important (3)</td>
<td>Essential (4)</td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>------------------------</td>
<td>--------------------</td>
<td>---------------</td>
<td>-------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Proper Zoning</td>
<td>1(3.7)</td>
<td>0(0.0)</td>
<td>2(7.4)</td>
<td>6(22.2)</td>
<td>18(66.7)</td>
<td>3.48</td>
<td>0.94</td>
</tr>
<tr>
<td>Access to Trunk Sewer</td>
<td>1(3.7)</td>
<td>0(0.0)</td>
<td>0(0.0)</td>
<td>13(48.1)</td>
<td>13(48.1)</td>
<td>3.37</td>
<td>0.84</td>
</tr>
<tr>
<td>Price of Land</td>
<td>2(7.4)</td>
<td>1(3.7)</td>
<td>2(7.4)</td>
<td>12(44.4)</td>
<td>10(37.0)</td>
<td>3.00</td>
<td>1.44</td>
</tr>
<tr>
<td>Availability of Developable Land</td>
<td>1(3.7)</td>
<td>2(7.4)</td>
<td>5(18.5)</td>
<td>6(22.2)</td>
<td>13(48.2)</td>
<td>3.04</td>
<td>1.16</td>
</tr>
<tr>
<td>Nearness to Schools</td>
<td>1(3.7)</td>
<td>4(14.8)</td>
<td>8(29.6)</td>
<td>11(40.7)</td>
<td>3(11.1)</td>
<td>2.41</td>
<td>1.01</td>
</tr>
<tr>
<td>Nearness to Major Roads</td>
<td>3(11.1)</td>
<td>4(14.8)</td>
<td>8(29.6)</td>
<td>9(33.3)</td>
<td>3(11.1)</td>
<td>2.19</td>
<td>1.18</td>
</tr>
<tr>
<td>Nearness to Major Shopping Areas</td>
<td>2(7.4)</td>
<td>5(18.5)</td>
<td>7(25.9)</td>
<td>11(40.7)</td>
<td>2(7.4)</td>
<td>2.22</td>
<td>1.09</td>
</tr>
<tr>
<td>Size of Site</td>
<td>7(25.9)</td>
<td>3(11.1)</td>
<td>8(29.6)</td>
<td>6(22.2)</td>
<td>3(11.1)</td>
<td>1.81</td>
<td>1.36</td>
</tr>
</tbody>
</table>
quite possibly reflects the different market that they cater to (that is, their market is less likely to be in the child rearing stage of the life cycle than the market for single family dwellings). The higher weight given to nearness to major roads by developers of multiple family dwellings (2.36 vs. 2.07 and 2.19) reflects a concern for accessibility tempered by the typically high traffic flows of high density areas. The lower weight given to nearness to major shopping areas by developers of multiple family dwellings (2.05 vs. 2.29 and 2.22) may relate to the fact that apartments necessarily locate in higher density areas which are by necessity near major shopping areas. Therefore, the distance to shopping centres from within the higher density areas is, comparatively speaking, of less concern than the distance to shopping centres from suburban areas. The higher weight given to size of site by developers of multiple family dwellings (2.34 vs. 1.93 and 1.81) reflects the higher interdependency of site size, project size, and availability of developable land in the higher density areas.
Trends Identified

Throughout the interviews, developers who, being of larger scale had their option of which housing type to develop, indicated their intention to construct more garden apartments and condominiums, and to reduce their construction of single family dwellings. This is also the conclusion obtained from the results of questions III 1 and 3.

<table>
<thead>
<tr>
<th>Housing Type</th>
<th>Developed in Past</th>
<th>To Be Developed In Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family Dwellings</td>
<td>80%</td>
<td>68%</td>
</tr>
<tr>
<td>Garden Apartments and/or condominiums</td>
<td>38%</td>
<td>66%</td>
</tr>
<tr>
<td>Row Housing</td>
<td>28%</td>
<td>34%</td>
</tr>
<tr>
<td>Low Rise Multiple</td>
<td>45%</td>
<td>32%</td>
</tr>
<tr>
<td>High Rise Multiple</td>
<td>30%</td>
<td>29%</td>
</tr>
</tbody>
</table>

This necessarily understates the case because of the large number of small scale developers of single family dwellings who, because of their limited financial resources, are necessarily confined to continue building single family dwellings.
Also discernible is a trend away from construction of low rise multiple dwellings. This would add substance to the general consensus in the interviews that the market for low rise multiple dwellings had declined substantially as a result of the changes to the Income Tax Act in 1972.

Political Climate

Overwhelming concern during the interviews was placed on the political climate - the new NDP government making rash moves concerning subdivision and possibly zoning, increasing power of tenants groups, the possibility of national wage and price (rent) controls. Numerous times reference was made to "red tape" and "political manoeuvring" on the part of municipal bodies and of pressure groups. Forty-nine percent of all developers interviewed had discontinued at least one project because of difficulties in obtaining zoning (question IV 5).

In West Vancouver, the Municipal Council has set an upper limit on elevation of development at 8,000 feet. North Vancouver District has a policy of rationing a limited number of new lots of its extensive holdings for development each year. In Port Moody,
development plans for a large undeveloped property are presently being made with a restricted small group of private developers. Provisions of Section 702A under the Municipal Act enable the Municipality of Surrey to make additional charges for such things as access roads, paving of nearby roads, enlargement of sewer trunks - costs previously borne by the municipality.

This is the environment within which developers must work. It has a profound effect on their activities and therefore on the growth of our cities.
Hypotheses and Measurement of Variables

The Study Area

The area selected for study of Vancouver's growth patterns was that defined by the 1961 Census Tracts of the Metropolitan Area. The area is bounded in the north by the mountains (Districts of West and North Vancouver), in the east by Pitt River (District of Coquitlam) and 200th Street (the eastern boundary of Surrey), in the south by the U.S. border and in the west by the Strait of Georgia. The area is divided into 119 Census Tracts (see map, Appendix B) of varying size each with a population of roughly 6,000 to 10,000. Although the Census Tracts of 1966 and 1971 changed boundaries in some cases to accommodate increasing populations, this was accounted for in the calculations.

To recapitulate, location factors which were weighted of average importance or greater by all respondents to the questionnaire are:

1. Proper Zoning
2. Access to Trunk Sewer
3. Price of Land
4. Availability of developable land
5. Nearness to schools
6. Nearness to major roads
7. Nearness to major shopping areas
8. Size of site

Hypothesis 1: The number of completions of single family detached housing units is related to the amount of land zoned for single family detached housing which is underdeveloped.

\[ ULZ_{sfd} = A_{sfd} - \left( \frac{U_{sfd}}{D_{sfd}} - ULZ_{(apt+sdf)} \right) \]

where \( ULZ_{sfd} \) = underdeveloped land zoned for single family detached housing (acres)

\( A_{sfd} \) = Acreage zoned for single family detached housing

\( U_{sfd} \) = Number of existing units of single family detached housing

\( D_{sfd} \) = Density of use (units of single family detached housing per acre)

\( ULZ_{(apt+sfa)} \) = Underdeveloped land zoned for apartment and single family attached housing (acres).

See Hypothesis 2.
To properly account for land occupied by single family detached housing but which is zoned for higher density use, accommodation is made through subtraction of $ULZ_{(apt+sfa)}$, the amount of underdeveloped land zoned for apartment and single family attached housing. This quantity is defined in Hypothesis 2.

Hypothesis 2: The combined number of completions of apartment and single family attached housing units is related to the amount of land zoned for apartment and single family attached housing which is underdeveloped.

$$ULZ_{(apt+sfa)} = A_{(apt+sfa)} - \frac{U_{(apt+sfa)}}{D_{(apt+sfa)}}$$

where: $ULZ_{(apt+sfa)} =$ Underdeveloped land zoned for apartment or single family attached housing (acres);

$A_{(apt+sfa)} =$ Acreage zoned for apartments or single family attached housing;

$U_{(apt+sfa)} =$ Number of existing units of apartment and single family attached housing;
\[ D(\text{apt+sfa}) = \text{Density of use (units of apartment and single family detached housing per acre)}. \]

The grouping of acreages zoned for apartments and single family attached housing into one factor was made for two reasons:

a) Zoning codes for the different municipalities failed to differentiate clearly between the two types of housing. In many cases, the restrictions varied over time and applications for building permits were evaluated on an individual basis thereby reducing the predictive nature of the zoning.

b) Census information, upon close examination differentiated between single family attached and apartment housing in a much more literal manner than that of the zoning codes. It was realized, for example, that many dwelling units classified as single family attached by zoning codes were designated as apartments in the Censuses. It was for these reasons that reasonable results could be obtained only by the aggregation of these two housing types, much to the disappointment of the researcher.
The acreages of each zoning classification were obtained from municipal zoning maps for 1970. Earlier zoning maps were not readily available so the assumption was made that zoning changes slowly over time. The zoned acreages for 1970 were used for all calculations. The existing units of single family detached and for apartment and single family attached housing for 1961 and 1966 were available from 1961 and 1966 Censuses. When regressing completions of 1961-66, and 1966-71, the units existing at the beginning of the periods (i.e., 1961 and 1966 respectively) were used.

It was very difficult to obtain accurate information for the density of use (units/acre). Two methods were attempted:

1. The average lot size from sales in 1968 of the Multiple Listing Service was calculated by municipality.

The Multiple Listing Service lists homes for sale which tend to be lower priced than the average. Although this biased the sample toward a smaller lot size, there was an opposite bias because of the larger lots which were being sold for subdivision (especially in the outlying areas). Attempts were made to account for the latter bias yet it is difficult to ascertain which bias was stronger.
To account for roads, the average lot size was scaled upward by one-third. Finally, the average lot size per Census Tract was determined in an ad hoc fashion by referral to the minimum lot size of the various zones and a reasonableness check made through visual inspection of a very large aerial photograph of the region. For apartment densities, adjustment was made according to the maximum density permitted under the various zoning codes.

2. The second method of obtaining densities of use involved using land use data gathered for a similar study. The numbers of units in 1961 and 1966 were divided by the amount of land used in each Census Tract (the data was gathered in some cases over two or three Census Tracts so that an averaging procedure was required). Inspection of the data for several Census Tracts yielded unreasonable densities which were adjusted through comparison to areas of similar densities. This left some doubt as to the accuracy of the entire land use data and of the calculated densities of use.
Hypothesis 3: The number of completions of single family detached housing units is related to the amount of unused single family detached housing potential.

\[
UP_{sfd} = TP_{sfd} - U_{sfd}
\]

where \(UP_{sfd}\) = Unused single family detached housing potential;

\(TP_{sfd}\) = Total single family detached housing potential;

\(U_{sfd}\) = Number of existing units of single family detached housing.

Total potential for single family detached housing was calculated by taking the minimum lot size allowed by the various zoning codes, adjusting it upward by a factor of one-third to account for roads and dividing it into the zoned acreages of each zone.

Hypothesis 4: The combined number of completions of apartment and single family attached housing units is related to the amount of unused single family attached and apartment housing potential.
\[ UP(\text{apt+sfa}) = TP(\text{apt+sfa}) - U(\text{apt+sfa}) \]

where \( UP(\text{apt+sfa}) \) = Unused apartment and single family attached housing potential;

\( TP(\text{apt+sfa}) \) = Total apartment and single family attached potential;

\( U(\text{apt+sfa}) \) = Number of existing units of apartment and single family attached housing.

Total potential for apartment and single family attached housing was calculated by taking the maximum floor area ratio permitted by the various zoning codes and adjusting it downward by one-quarter to account for roads. Then using an average gross suite size of 800 square feet, the maximum apartment unit potential was found. Again the number of existing units at the beginning of the period were used (housing units in 1961 and 1966 were used for regressions against completions of 1961-66 and 1966-71).
Hypothesis 5: The number of completions of single family detached housing units is related to the total single family housing unit potential.

Hypothesis 6: The combined number of completions of apartment and single family attached housing units is related to the total single family attached and apartment housing unit potential. Total housing potential is calculated in the manner described under Hypotheses 3 and 4.

Hypothesis 7: The number of completions of single family detached housing units is inversely related to the price of land.

Hypothesis 8: The combined number of completions of apartment and single family attached housing units is inversely related to the price (per apartment unit) of land.

Price levels of typical lots in 1964 and 1969 (used in regressions against completions in 1961-66 and 1966-71 respectively) were obtained for each of three or four smaller areas of each municipality. These price levels were applied to the relevant Census Tracts. For apartments, in order to accommodate for variation of intensity of use, the price per unit was used.
Hypothesis 9: The number of completions of single family detached housing units is related to the travel time (by motor vehicle) from the central business district.

Hypothesis 10: The combined number of completions of apartment and single family housing units is related to the travel time (by motor vehicle) from the central business district.

Travel isochrones from the central business district were available for 1968. The travel times to the Census Tracts for 1963 were estimated from travel isochrones for 1956 and road maps of 1963.

Hypotheses 11 to 14 were not tested due to insufficient data as explained below.

Hypothesis 11: The number of completions of the different housing types is related to access to trunk sewer.

In August 1968, regulations were established requiring development in areas denoted "Urban Growth Areas" to be serviced by sewers. Every Census Tract is serviced to some degree by sewer trunks. Ideally, the data needed for each Census
Tract is the amount of underdeveloped residentially zoned land with ready access to sewers. Trunk sewers are distributed spatially in a very irregular fashion, somewhat following the outline of residentially zoned areas. There was no means available for obtaining data of that portion of areas zoned residential, underdeveloped, yet with access to sewers.

Hypothesis 12: The number of completions of the different housing types is related to "nearness" to schools.

Every Census Tract has accessibility to schools to some degree. The problem is complicated by the following factors:

1. In outlying Census Tracts there are a large number of small schools and in the cities the fewer number of schools have a larger number of rooms and teachers and therefore a larger student capacity.

2. Accessibility to elementary schools is necessarily within a smaller radius that that of secondary schools.

3. Some of the outlying Census Tracts are so large that the distribution of schools within the Census Tract is important.
Hypothesis 13: The number of completions of the different housing types is related to "nearness" to major roads.

Some portion of almost all Census Tracts are "near" a major road, that is, within a few minutes drive of a major road. With a finer spatial disaggregation, it is expected that a good proxy for this factor (perhaps accessibility within some small number of minutes) could be obtained and included in the regression.

Hypothesis 14: The number of completions of the different housing types is related to "nearness" to major shopping areas.

In almost every case, some portion of each Census Tract is readily accessible to a major shopping area. Again, a finer spatial disaggregation would likely allow a good proxy for this factor (perhaps accessibility within some small number of minutes).

Although the site size is ranked of average importance, its importance relates more to suitability to a particular project than to an overall desire for large sites or small sites. It is, therefore, difficult to incorporate site size as one of the variables in the regression.
Hypothesis 15: The population density of Metropolitan Vancouver is related to distance from the central business district in the form of an exponential, as described by Clark

\[ y = Ae^{-bd} \]

Population per Census Tract was available for 1961 and 1966 from Dominion Bureau of Statistics publications. Preliminary results of the 1971 Census, which were available from the local D.B.S. office were used. The total area of each Census Tract was also available from the local D.B.S. office.

The distance "as the crow flies" from the CBD was measured from the Census map in millimetres.

Hypothesis 16: The population density of residentially zoned land in Metropolitan Vancouver is related inversely to the travel time to the central business district.

The total area of residentially zoned land in each Census Tract was obtained in the manner described in relation to Hypotheses 1 and 2.
Hypothesis 17: The housing unit density of residually zoned land in Metropolitan Vancouver is related inversely to the travel time from the central business district.

Housing unit densities of residually zoned land were determined using housing unit information from the 1961 and 1966 Censuses. The number of housing units in 1971 was determined by adding completions of the three housing types (sfd, sfa, and apt) for each Census Tract as obtained from CMHC source data (see page 87).

Hypothesis 18: Housing unit completions are related to the amount of unused population potential as determined by the difference between the observed population density and that calculated by Clark's Theory in Hypothesis 15.

Hypothesis 19: Housing unit completions are related to the amount of unused housing potential as determined by the difference between the observed housing density and that calculated from the inverse relation between housing density and travel time from the CBD in Hypothesis 17.
The sample coefficient of determination is defined as \[ r^2 = \frac{\text{explained sum of squares of deviations}}{\text{total sum of squares of deviations}} \]

\[ = \frac{\sum (x_c - u)^2}{\sum (x_o - u)^2} \]

where \( x_c \) = calculated value of \( Y \)
\( x_o \) = observed value of \( Y \)
\( u \) = mean of \( Y \)

and \( x_o - u = (x_o - x_c) + (x_c - u) \)

Hence \( r^2 \) is a measure of explained variation with limits 0.0 and 1.0 for completely unexplained variation and completely explained variation respectively. Rearranging the above

\[ r^2 = 1 - \frac{\sum (x_o - x_c)^2}{\sum (x_o - u)^2} \]
Thus the $r^2$ statistic (which is that reported in all work in this study) is the coefficient of determination adjusted for the number of degrees of freedom.

The $t$ statistic of a normal distribution is approximated by the formula $^{74}$

$$t = \frac{\bar{x} - u}{\sigma/\sqrt{n}}$$

Where $\bar{x}$ = sample mean

\[ u = \text{actual mean} \]

\[ \sigma = \text{standard deviation} \]

\[ n = \text{number of observations in the sample} \]

Thus the $t$ statistic is a measure of the accuracy of the sample mean. The probability of a sample mean occurring by chance is given by comparison to values in a table of $t$ statistics.\(^{75}\)

For 118 degrees of freedom:

$P(t > 3.38) = 0.0005$

$P(t > 2.62) = 0.005$

$P(t > 2.36) = 0.01$

$P(t > 1.99) = 0.025$

$P(t > 1.66) = 0.05$

$P(t > 1.29) = 0.10$

$P(t > 0.68) = 0.25$
For 43 degrees of freedom (applicable for completions of single family detached housing), 
\[ P(t > 2.70) = 0.005 \]

By way of reference to the F statistic, \( t^2 \) has a F distribution with 1 and \( n-1 \) degrees of freedom in results of standard multiple linear regression. That is, \[ t^2 = \frac{1}{F_{n-1}} \]

The t test considers the case of \( \bar{x} < u \) and \( \bar{x} > u \) hence is a 2-tail test. In the F test, the comparison is of \( (\bar{x} - u)^2 \) and having only positive value, is a 1-tail test. Therefore the relation above is true for a level of significance (probability) of \( \alpha/2 \) for the t statistic and \( \alpha \) for the F statistic.

In the tables, the Regression Coefficients (C for example), the Standard Error \( \sigma_C \) and the Student t Statistic \( t_C \) are listed where applicable. By definition \[ t_C = \frac{C}{\sigma_C} \]
Regression Results

Data for the number of housing unit completions for 1961-66 and 1966-71 was determined as follows:

The number of rental housing unit completions per Census Tract was available for the periods 1961-66 and 1966-71 from source data of annual CMHC rental vacancy studies. From other CMHC source data, the total number of apartment completions per municipality was available. The data, which was available from the local CMHC office was the raw data of annual CMHC housing studies. The rental unit completions were simply scaled upward to correspond to the total completions per municipality.

The difference between the single family detached housing units of the 1961 and 1966 Censuses were scaled to correspond to the completions per municipality as available from CMHC source data. Distribution of the CMHC completion (single family detached) data for 1966-71 was accomplished through visual inspection of the changes between the G.V.R.D. Existing Development Maps of 1968 and 1970. This was, admittedly, a rough treatment of the data, but considerable care was taken yielding surprisingly good results. These approaches were not felt to be applicable
in the cases of Vancouver and Burnaby so that the regressions of completions of single family detached (for both 1961-66 and 1966-71) cover only the remaining forty-four Census Tracts.

**TABLE V**

Regression Results "Measures of Attractiveness"

<table>
<thead>
<tr>
<th>Completions</th>
<th>( r^2 )</th>
<th>Student t Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( 1/\text{Price} )</td>
</tr>
<tr>
<td>sfd 61-66</td>
<td>0.09</td>
<td>-0.56</td>
</tr>
<tr>
<td>sfd 61-66*</td>
<td>0.14</td>
<td>-0.53</td>
</tr>
<tr>
<td>sfd 66-71</td>
<td>0.36</td>
<td>-0.86</td>
</tr>
<tr>
<td>sfd 66-71*</td>
<td>0.05</td>
<td>-0.48</td>
</tr>
<tr>
<td>apt 61-66</td>
<td>0.10</td>
<td>-0.71</td>
</tr>
<tr>
<td>apt+sfa 61-66</td>
<td>0.16</td>
<td>-0.58</td>
</tr>
<tr>
<td>apt 66-71</td>
<td>0.15</td>
<td>2.32</td>
</tr>
<tr>
<td>apt+sfa 66-71</td>
<td>0.05</td>
<td>0.88</td>
</tr>
</tbody>
</table>

* In these regressions, allowance was not made for acreage zoned for apartments but not yet occupied by apartments (assumed entirely occupied by single family detached housing). This was to test the possibility that errors resulting from approximations in calculating this amount were preventing obtaining meaningful statistics.
TABLE VI

Regression Results of "Unused and Total Potential"

Completions = a + b x Unused Potential

<table>
<thead>
<tr>
<th>Completions</th>
<th>a</th>
<th>$\sigma_a$</th>
<th>$t_a$</th>
<th>b</th>
<th>$\sigma_b$</th>
<th>$t_b$</th>
<th>$- \frac{r}{\sigma}$</th>
<th>Degrees of Freedom</th>
</tr>
</thead>
<tbody>
<tr>
<td>sfd 1961-66</td>
<td>19824.1</td>
<td>5744.3</td>
<td>3.45 *</td>
<td>1.62</td>
<td>0.50</td>
<td>3.26 *</td>
<td>.18</td>
<td>43</td>
</tr>
<tr>
<td>sfd 1966-71</td>
<td>93.9</td>
<td>83.6</td>
<td>1.12</td>
<td>0.0675</td>
<td>0.0074</td>
<td>9.12 *</td>
<td>.66</td>
<td>43</td>
</tr>
<tr>
<td>apt+sfa 1961-66</td>
<td>4082.8</td>
<td>3807.8</td>
<td>1.07</td>
<td>11.79</td>
<td>1.29</td>
<td>9.11 *</td>
<td>.41</td>
<td>118</td>
</tr>
<tr>
<td>apt+sfa 1966-71</td>
<td>15994.7</td>
<td>3822.9</td>
<td>4.18 *</td>
<td>14.17</td>
<td>1.54</td>
<td>9.19 *</td>
<td>.41</td>
<td>118</td>
</tr>
<tr>
<td>apt 1966-71</td>
<td>16602.9</td>
<td>3749.0</td>
<td>4.43 *</td>
<td>13.89</td>
<td>1.48</td>
<td>9.39 *</td>
<td>.42</td>
<td>118</td>
</tr>
</tbody>
</table>

Completions = c + d x Total Potential

<table>
<thead>
<tr>
<th>Completions</th>
<th>c</th>
<th>$\sigma_c$</th>
<th>$t_c$</th>
<th>d</th>
<th>$\sigma_d$</th>
<th>$t_d$</th>
<th>$- \frac{r}{\sigma}$</th>
<th>Degrees of Freedom</th>
</tr>
</thead>
<tbody>
<tr>
<td>sfa 1961-66</td>
<td>16738.7</td>
<td>5947.4</td>
<td>2.81 *</td>
<td>1.70</td>
<td>0.47</td>
<td>3.63 *</td>
<td>.22</td>
<td>43</td>
</tr>
<tr>
<td>sfd 1966-71</td>
<td>2.89</td>
<td>91.8</td>
<td>0.03</td>
<td>0.063</td>
<td>0.0072</td>
<td>8.73 *</td>
<td>.64</td>
<td>43</td>
</tr>
<tr>
<td>apt+sfa 1961-66</td>
<td>2048.0</td>
<td>3673.0</td>
<td>0.56</td>
<td>10.65</td>
<td>1.05</td>
<td>10.17 *</td>
<td>.46</td>
<td>118</td>
</tr>
<tr>
<td>apt+sfa 1966-71</td>
<td>11449.0</td>
<td>3546.0</td>
<td>3.23</td>
<td>11.61</td>
<td>1.01</td>
<td>11.49 *</td>
<td>.53</td>
<td>118</td>
</tr>
<tr>
<td>apt 1966-71</td>
<td>12164.5</td>
<td>3394.0</td>
<td>3.58</td>
<td>12.61</td>
<td>1.04</td>
<td>12.11 *</td>
<td>.55</td>
<td>118</td>
</tr>
</tbody>
</table>

* $P(t \geq 2.62) = 0.005$, $P(t \geq 2.70) = 0.005$
The regression results of Table V do not support Hypotheses 1 and 2 (completions vs. underdeveloped land). The results shown are those using the second method of calculating density of use. Those results using the first method, which were very similar, are not shown. However, in both cases, considerable doubt exists concerning the accuracy of the data and therefore the conclusion is not conclusive.

Hypotheses 3 and 4 (completions vs. unused housing potential) as well as Hypotheses 5 and 6 (completions vs. total housing potential) are supported by the regression results shown in Table VI. All Student t statistics are well within the 0.005 significance level. The lower $r^2$ for completions of single family detached 1961-66 may be explained by the fact that housing potential for 1966 was calculated from zoning data of 1970. Further this regression was over the outlying Census Tracts (those other than Vancouver and Burnaby) where the zoning has changed most. Therefore $UP_{sfd}$ and $TP_{sfd}$ were too high which produced lower $r^2$ than would otherwise have been expected.

Table VI shows the results of the same regressions for completions of apartments and single family attached housing combined and for completions of apartments only. The only slightly better results obtained with completions of apart-
ments only indicated that the results were not significantly altered by the aggregation of data for apartment and single family attached housing.

Hypotheses 7 and 8 are not supported by the results shown on Table V. That is, developers claim that price is important yet it does not appear to be a significant determinant in explaining the location of housing unit completions.

Hypotheses 9 and 10 (completions vs. travel time from CBD) are not supported by the results shown on Table V.

Hypothesis 15 (Pop/Total Area = Ae^{-bd}) is supported by the regression results shown in Table VII. Taking natural logarithms the equation becomes

\[ \log(\text{Pop/Total Area}) = -bd + \text{Constant}. \]

where d = distance from the central business district.

\textbf{T A B L E VII}

Regression Results of \[ \log(\text{Pop/Total Area}) = -bd + C \]

<table>
<thead>
<tr>
<th>Year</th>
<th>C</th>
<th>\sigma_C</th>
<th>t_C</th>
<th>b</th>
<th>\sigma_b</th>
<th>t_b</th>
<th>r^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>4.89</td>
<td>0.14</td>
<td>33.88</td>
<td>-0.015</td>
<td>0.0014</td>
<td>-10.47*</td>
<td>.48</td>
</tr>
<tr>
<td>1966</td>
<td>4.94</td>
<td>0.14</td>
<td>34.49</td>
<td>-0.014</td>
<td>0.0014</td>
<td>-10.08*</td>
<td>.46</td>
</tr>
<tr>
<td>1971</td>
<td>4.93</td>
<td>0.14</td>
<td>34.87</td>
<td>-0.013</td>
<td>0.0014</td>
<td>-9.15*</td>
<td>.41</td>
</tr>
</tbody>
</table>

* \( P(t > 2.62) \approx 0.005 \)
Although the results explain only approximately one-half of the variation, application of Clark's Theory is complicated by the existence of the Burrard Inlet and the mountains on the North Shore.

An adaptation of Clark's Theory is that of

\[ \text{Pop/Area Zoned Residential} = Ae^{-bt} \]

where \( t \) = travel time from the CBD. The regression results are approximately the same as those of Table VII. However, in working with the graph of \( \log (\text{Pop/Area Zoned Residential}) \) vs. time, it was noticed that a better fit would be obtained using \( \log(t) \) rather than time. The subsequent regression led to multipliers of approximately -1.0 and therefore to the much better predictor results of

\[ \text{Pop/Area Zoned Residential} = C_1/\text{time} \]

<table>
<thead>
<tr>
<th>Year</th>
<th>( C )</th>
<th>( \sigma_C )</th>
<th>( t_C )</th>
<th>( r^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961*</td>
<td>213.63</td>
<td>16.69</td>
<td>12.80</td>
<td>.59</td>
</tr>
<tr>
<td>1966*</td>
<td>252.15</td>
<td>18.72</td>
<td>13.47</td>
<td>.61</td>
</tr>
<tr>
<td>1971*</td>
<td>383.19</td>
<td>24.63</td>
<td>15.56</td>
<td>.68</td>
</tr>
</tbody>
</table>
* Omission of Census Tracts 5, 6, 14 and 178 because the area zoned residential was very small or zero.

Hypothesis 17 (housing density vs. the reciprocal of travel time from the central business district) is supported in much the same manner as Hypothesis 16 by the results shown in Table IX.

TABLE IX

<table>
<thead>
<tr>
<th>Year</th>
<th>C</th>
<th>$\sigma_c$</th>
<th>$t_c$</th>
<th>$\frac{r^2}{\text{time}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961*</td>
<td>91.98</td>
<td>4.54</td>
<td>20.23</td>
<td>.65</td>
</tr>
<tr>
<td>1966*</td>
<td>135.74</td>
<td>7.81</td>
<td>17.38</td>
<td>.62</td>
</tr>
<tr>
<td>1971*</td>
<td>263.08</td>
<td>14.40</td>
<td>18.27</td>
<td>.74</td>
</tr>
</tbody>
</table>

* Omission of Census Tracts 5, 6, 14, and 178 because the area zoned residential was very small or zero.

Hypothesis 18 (completions vs. unused population density as determined by Clark's Theory) and Hypothesis 19 (completions vs. unused housing potential as determined by the inverse travel time relation) were tested in three manners:
(a) Housing unit completions were regressed against both positive negative differences between calculated and observed densities;

(b) Housing unit completions were regressed against only positive differences between calculated and observed densities;

(c) Housing unit completions were regressed against a dummy variable representing simply the existence of unused potential (1 for positive differences and 0 for zero or negative differences between calculated and observed densities)

The regression results obtained in manner (a) above were not significant. The highest $r^2$ obtained in support of Hypothesis 18 (Completions vs. Clark's Theory) was 0.078. The highest $r^2$ obtained in support of Hypothesis 19 (Completions vs. unused housing potential, as determined by the inverse travel time relation) was 0.076. In no instance did the $t$ statistic reach a level of significance of 0.05.

The regression results obtained in manner (b) were even less significant than those obtained in manner (a).
In the regressions against the dummy variable in manner (c), the $\bar{r}^2$ obtained were very low. However, the t statistics were high, in all cases indicating a significance level greater than 0.0005 (Tables X & XI). This indicates that the existence of unused potential is in itself significant in the determination of housing unit completions. The results of investigations in manners (a) and (b) indicate that the magnitude of the difference between observed and calculated densities is not significant in the determination of the number of housing unit completions. In other words, the existence of housing unit potential as determined by the difference between observed and calculated densities (by both Clark's Theory and the Inverse Travel Time Relation) is a determinant only of whether or not housing unit completions take place and not of the actual number of housing unit completions. Admittedly, the size of the subareas used in these regressions has some bearing on this statement. The negative values for $\bar{r}^2$ the tables are explained simply by the fact that the $\bar{r}^2$ were too low to be significant in the manner of the $\bar{r}^2$ matrix calculations of the regression package (MASS:AGER).
TABLE X

Regression Results of Completions vs. Dummy Variable Representing Existence of Unused Potential as Determined by Clark's Theory

<table>
<thead>
<tr>
<th>Completions (Year)</th>
<th>Dummy (Year)</th>
<th>C</th>
<th>$\sigma_C$</th>
<th>$t_C$</th>
<th>$r^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961-66</td>
<td>1961</td>
<td>40239</td>
<td>8130</td>
<td>4.95*</td>
<td>-0.29</td>
</tr>
<tr>
<td>1966-71</td>
<td>1966</td>
<td>23708</td>
<td>6929</td>
<td>3.42*</td>
<td>-0.35</td>
</tr>
<tr>
<td>1961-71</td>
<td>1961</td>
<td>69808</td>
<td>14615</td>
<td>4.77*</td>
<td>-0.38</td>
</tr>
</tbody>
</table>

* $P(t>3.38)_{118} = 0.0005$

TABLE XI

Regression Results of Completions vs. Dummy Variable Representing Existence of Unused Potential as Determined by the Inverse Travel Time Relation

<table>
<thead>
<tr>
<th>Completions (Year)</th>
<th>Dummy (Year)</th>
<th>C</th>
<th>$\sigma_C$</th>
<th>$t_C$</th>
<th>$r^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961-66</td>
<td>1961</td>
<td>38399</td>
<td>6750</td>
<td>5.69*</td>
<td>-0.22</td>
</tr>
<tr>
<td>1966-71</td>
<td>1966</td>
<td>24837</td>
<td>6175</td>
<td>4.02*</td>
<td>-0.28</td>
</tr>
<tr>
<td>1961-71</td>
<td>1961</td>
<td>64225</td>
<td>12265</td>
<td>5.23*</td>
<td>-0.34</td>
</tr>
</tbody>
</table>

* $P(t>3.38)_{118} = 0.0005$
Conclusion

Total housing potential and unused housing potential (as defined by capacity and unused capacity of zoning) both explain between forty and sixty-five per cent of the variation in the spatial distribution of housing completions. Land price and travel time from the central business district were not significant explanatory variables.

The importance of the significant results concerning the number of housing unit completions as a function of potential (determined by the amount of residentially zoned land) lies in the reaffirmation of planners' power of directing development and redevelopment through zoning. That price of land and travel time from the central business district did not appear to be significant determinants of the location of new housing allows the planner to discount the importance of these factors in his formulation of the city plan. Through judicious use of his knowledge of the total housing potential, the unused potential, and his own estimate of the
possibility of development (based in part on the condition of the existing use), the planner has at his disposal the most significant factor affecting the spatial distribution of future residential development.

Clark's Theory of Exponentially Declining Densities explains only between forty and fifty per cent of the variation in population density.

A much better relation which explains between sixty and seventy per cent of population in residentially zoned areas is

\[
\text{Pop/Area Zoned Residential} = \frac{C_1}{t}
\]

where \( t \) is the travel time from the central business district. In a similar relation, sixty-five to seventy-five per cent of the housing unit density in residentially zoned areas is explained:

\[
\text{Housing/Area Zoned Residential} = \frac{C_2}{t}
\]

However the theory behind such a relation, the foundation for any predictive value, has yet to be explained.
Attempts were made to correlate the number of housing unit completions in a subarea with the difference between the observed density and that calculated by Clark's Theory and by the Inverse Travel Time Relation. In subareas in which differences exist, housing development was expected which would bring the actual density more in line with the density calculated from these theories. However the existence of housing unit potential thus calculated is a significant determinant only of whether or not housing unit completions take place. Congruently, the magnitude of the housing unit potential is not a significant determinant of the actual number of housing unit completions.
This study is a first step toward a more complete understanding of city growth patterns. The results which demonstrate the significance of housing potential in determining the location of new residential development confirms our expectations. However, that price of land and travel time from the central business district do not appear to be significant provides knowledge in areas which previously were subjects of speculation and conjecture.

A more complete analysis of potential factors affecting the location of new residential development could possibly provide a very powerful tool for the prediction of city growth. The importance of such a tool accelerates with the passage of time as cities face the perplexing problems of urban "sprawl" and decaying inner areas, of urban renewal, of alternative modes of transportation attacking the preeminence of the automobile, and of the immense complexities of social problems in the city.
The next step following the direction of this study toward a better understanding of city growth (and therefore of the associated problems) is the testing of hypotheses relating to housing completions by type as a function of such factors as:

- access to sewage trunks;
- nearness to schools;
- nearness to major shopping areas;
- nearness to major roads;
- nearness to bus routes;
- nearness to industrial areas;
- socioeconomic rank.

The inclusion of such variables would necessitate a fine spatial disaggregation with cell size of the order of one-quarter mile square. Accumulation of such data by cell could provide an excellent data base for more extensive and exhaustive work.

One of the overwhelming concerns of the writer was the lack of consistency of zoning codes between municipalities. For meaningful study of city growth patterns and for a sensible long term approach to the problems of urbanization, leadership must be provided and efforts made toward a consolidated
planning scheme. Steps in this direction are currently being made by Municipal Affairs Minister James Lorimer in the cities of Kelowna and Kamloops where the city boundaries are being extended to include several surrounding rapidly growing unincorporated areas.
Footnotes

1. Kaiser and Weiss (1970) p. 31
2. ibid.
3. ibid.
4. ibid., p. 32
10. ibid., p. 33
11. ibid., p. 44
12. ibid., p. 55
13. Eldridge (1967) p. 54
15. Kaiser and Weiss (1970) p. 34
19. McAllister (1967)
20. Reid (1958)
22. Lee (1964)
23. Oksanen (1966)
24. Uhler (1968)
26. ibid., p. 34
27. Reid, M. (1958)
28. Muth (1968)
29. Lee (1964)
30. Chung (1967) p. 79
32. Bourne (1968)
33. Smith, W.F. (1964)
34. Grebler and Maisel (1963)
35. ibid., p. 497
36. Maisel (1963)
37. Muth (1960)
38. Smith, W.F. (1966)
40. Wullkopf (1969)
41. Smith, L.B. (1971)
42. Burgess (1925) p. 50
43. Colby (1959)
44. Hoyt (1939)
45. Harris and Ullman (1959)
46. Clark (1951)
47. Kain (1962)
48. Alonso (1965)
49. Wingo (1961)
50. Stegman (1969)
51. Chapin (1965b)
52. Hamburg and Creighton (1959)
53. Donnelly et. al. (1964),
    Chapin and Weiss (1962),
    and Chapin (1965a)
54. Donnelly et. al. (1964)
55. Harris, Colin C. (1966)
56. Hill (1965)
57. Lowry (1964)
58. Steger (1965)
59. B.A.S.S. (1968)
60. Goldner (1971)
61. Herbert and Stevens (1960)
62. Harris, Britton (1963)
63. Robinson et. al. (1965)
64. Sears (1971)
65. Stegman (1969)
66. Mittelbach et. al. (1970)
67. C.M.H.C. (1971) (only dwelling units financed by NHA loans to builders (and not to owners) are included)
68. Real Estate Board of Greater Vancouver (1964, 66, 68, and 70)
69. G.V.R.D./ Planning Dept. (1968)
70. Technical Commission for Metropolitan Highway Planning (B.C.) (1959) figure 4.1
71. Dominion Bureau of Statistics (1968)
72. Yamane (1964) p. 393
73. ibid., p. 402
74. ibid., p. 509
75. ibid., p. 878
76. ibid., p. 656
77. ibid.
Bibliography


B.A.S.S. (1968) Jobs, People and Land, Bay Area Simulation Study Centre for Real Estate and Urban Economics, Institute of Urban and Regional Development, University of California, Berkeley

Baxter, D., M.A. Goldberg, D. Lach, and G. Mason (1972) "Toward a Regional Housing Model: An unpublished paper, Dept. of Commerce and Business Administration, University of British Columbia, Vancouver


Central Mortgage and Housing Corporation (1971) Canadian Housing Statistics 1970 Ottawa

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<th>Author(s)</th>
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<td>Chapin, F.S. Jr. (1972)</td>
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<td>Selected References on Urban Planning Concepts and Methods, Chapel Hill, North Carolina: Dept. of City and Regional Planning, University of North Carolina</td>
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<tr>
<td>Author(s)</td>
<td>Title</td>
<td>Publication Details</td>
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<td>Greater Vancouver Regional District/Planning Department (1968)</td>
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<td>Greater Vancouver Regional District/Planning Department (1968, 1970)</td>
<td>Existing Development Map, 1968 (and also 1970)</td>
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</table>
Harris, Colin C. (1966) Suburban Development as Stochastic Process Berkeley Center for Real Estate and Urban Economics, Institute of Urban and Regional Development: University of California


<table>
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<th>Author(s)</th>
<th>Year</th>
<th>Title</th>
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<tr>
<td>Lowry, I.S.</td>
<td>1960</td>
<td>&quot;Filtering and Housing Standards: A Conceptual Analysis&quot;</td>
<td></td>
</tr>
<tr>
<td>Lowry, I.S.</td>
<td>1964</td>
<td>A Model of Metropolis</td>
<td></td>
</tr>
<tr>
<td>Maisel, S.</td>
<td>1963</td>
<td>&quot;A Theory of Fluctuation in Residential Construction Starts&quot;</td>
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<tr>
<td>Maisel, S.</td>
<td>1965</td>
<td>Financing Real Estate</td>
<td></td>
</tr>
<tr>
<td>Massie, R.W.</td>
<td>1969</td>
<td>A System of Linked Models for Forecasting Urban Residential Growth</td>
<td></td>
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<tr>
<td>Mayhew, B.W.</td>
<td>1967</td>
<td>Local Areas of Vancouver</td>
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<tr>
<td>McAllister, D.</td>
<td>1967</td>
<td>&quot;The Demand for Rental Housing: An Investigation of Some Demographic and Economic Determinants&quot;</td>
<td></td>
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<tr>
<td>Mittelbach, F.D., D.M. McAllister and D.D. Casparis</td>
<td>1970</td>
<td>&quot;The Role of Removals From the Inventory in Regional Housing Markets&quot;</td>
<td></td>
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<tr>
<td>Muth, R.F.</td>
<td>1960</td>
<td>&quot;The Demand for Non-farm Housing&quot;</td>
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<tr>
<td>Muth, R.F.</td>
<td>1965</td>
<td>&quot;The Stock Demand Elasticities of Non-farm Housing: Comment&quot;</td>
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<td></td>
<td>Chicago: University of Chicago Press</td>
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<tr>
<td></td>
<td>Canadian Journal of Economics and Political Science 32:302-318</td>
<td></td>
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<tr>
<td></td>
<td>Homewood, Ill., U.S.A.: Irwin</td>
<td></td>
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<tr>
<td>Ratcliff, R.V. (1949)</td>
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<td>Reid, M.G. (1958)</td>
<td>&quot;Capital Formation in Residential Real Estate&quot;</td>
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<tr>
<td>Reid, M.G. (1962)</td>
<td>Housing and Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chicago: University of Chicago</td>
<td></td>
<td></td>
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<tr>
<td>Robinson, I.M., H.B.</td>
<td>&quot;A Simulation Model for Renewal Programming&quot;</td>
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<td></td>
<td>Simulation and Games 2:131-148</td>
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<tr>
<td>Smith, L.B. (1969)</td>
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<tr>
<td></td>
<td>Journal of Political Economy 77:795-816</td>
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<td>Smith, L.B. (1971)</td>
<td>Housing in Canada</td>
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<td></td>
<td>Research Monograph No.2 in Urban Canada, Problems and Prospects</td>
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<tr>
<td></td>
<td>Ottawa: Central Mortgage and Housing Corporation</td>
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<tr>
<td>Smith, W.F. (1964)</td>
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APPENDIX A

Housing Developer Questionnaire

We are currently engaged in a large scale study of housing in the Greater Vancouver Region. We are seeking information from developers in order to establish housing development patterns. Your help is greatly appreciated and your answers will be kept strictly confidential.

1. How long has your company been involved in real estate development? (number of years) 1-4

2. Is it a subsidiary of a larger company?
   (1) Yes
   (2) No 5-6

3. If so, what industry is the parent company associated with?
   (1) Lumber and Wood Products
   (2) Construction
   (3) Real Estate
   (4) Transportation
   (5) Agriculture and Fisheries
   (6) Other (please specify) 7

4. How many inside employees do you have?
   (management, office staff, secretarial help etc.) 9-11

5. How many outside employees do you have?
   (salesmen, construction workers, etc.) 12-14

6. Which facets of development do you engage in?
   A. Site Selection
      (1) Yes
      (2) No 15
   B. Site Planning
      (1) Yes
      (2) No 16
   C. Construction
      (1) Yes
      (2) No 17
   D. Selling and Leasing
      (1) Yes
      (2) No 18
   E. Property Management
      (1) Yes
      (2) No 19

7. Do you do subdivisions alone without constructing housing yourself?
   (1) Yes
   (2) No 20
8. Do you buy lots from subdividers?
   (1) Yes
   (2) No

9. Do you construct housing yourself?
   (1) Yes
   (2) No

10. If so, do you also do contract building?
    (1) Yes
    (2) No

11. How much in advance of construction do you usually acquire land? (number of years)

24-25

12. How many years inventory of land do you ordinarily hold at one time?

26-27

13. How many multiple family housing units will your company make available by the end of 1972?

28-30

14. How many were made available in 1971?

31-33

15. How many in 1970?

34-36

16. In which municipality did you locate the majority of these multiple family units

   in 1972
   in 1971
   in 1970

   (write in name to be coded later)

37

38

39

17. How many single family units will your company make available in 1972?

40-42

18. How many were made available in 1971?

43-45

19. How many in 1970?

46-48
20. In which municipality did you locate the majority of these single family units

in 1972 ____________________________

in 1971 ____________________________

in 1970 ____________________________

(write in name to be coded later)

21. (This question is applicable to those who are in subdivision only).

How many lots will you make available by the end of 1972? ____________________________

How many were made available in 1971? ____________________________

How many in 1970? ____________________________

In which municipality were most of these lots located

in 1972 ____________________________

in 1971 ____________________________

in 1970 ____________________________

(write in name to be coded later)

II. The next set of questions deal with the development process and the location decision.

1. (Interviewer: hand respondent card B and record response)

This is a list of various stages in the development process. Would you please place the stages in the order you think appropriate.

A. Arranging Financing ____________________________
B. Choosing type of development ____________________________
C. Choosing size of development ____________________________
D. Choosing a site ____________________________
E. Choosing a contractor ____________________________
F. Choosing a neighborhood ____________________________
G. Getting zoning changed (if needed) ____________________________
H. Getting building permit ____________________________
I. Other (please specify) ____________________________
2. I will read you a list of factors which related to your decision of whether or not to build. Would you please tell me for each factor whether it is

(0) Unimportant  
(1) Fairly important  
(2) of average Importance  
(3) Very Important  
or (4) Essential

(Interviewer: please indicate response) 1-4

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<th>Response</th>
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<tr>
<td>B. Interest rate</td>
<td>6</td>
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<tr>
<td>C. Population trends</td>
<td>7</td>
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<tr>
<td>D. Income trends in the region</td>
<td>8</td>
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<tr>
<td>E. Rent levels</td>
<td>9</td>
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<tr>
<td>F. Vacancy rates</td>
<td>10</td>
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<tr>
<td>G. Availability of developable land</td>
<td>11</td>
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<tr>
<td>H. Level of Construction in the region</td>
<td>12</td>
</tr>
<tr>
<td>I. Construction Costs</td>
<td>13</td>
</tr>
</tbody>
</table>

3. I will now read you a list of factors generally considered important in the location or site selection decision. Would you indicate relative importance of each in the same manner as before

<table>
<thead>
<tr>
<th>Factor</th>
<th>Response</th>
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<tbody>
<tr>
<td>A. Availability of developable land</td>
<td>14</td>
</tr>
<tr>
<td>B. Room for expansion</td>
<td>15</td>
</tr>
<tr>
<td>C. Price of land</td>
<td>16</td>
</tr>
<tr>
<td>D. Size of site</td>
<td>17</td>
</tr>
<tr>
<td>E. Nearness to major roads</td>
<td>18</td>
</tr>
<tr>
<td>F. Nearness to bus routes</td>
<td>19</td>
</tr>
<tr>
<td>G. Nearness to major shopping areas</td>
<td>20</td>
</tr>
<tr>
<td>H. Nearness to schools</td>
<td>21</td>
</tr>
<tr>
<td>I. Nearness to employment</td>
<td>22</td>
</tr>
<tr>
<td>J. Slope of site</td>
<td>23</td>
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<tr>
<td>K. Holding qualities of the soil</td>
<td>24</td>
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<tr>
<td>L. Access to trunk sewer</td>
<td>25</td>
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<tr>
<td>M. Proper zoning</td>
<td>26</td>
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</table>

4. Do you usually plan a project and then search for a site with qualities suitable for that project (1) OR do you usually just look for a "good buy" and plan a project for that site (2)? (Interviewer: indicate response as either 1 or 2). 

27
5. Do you usually choose sites with a particular economic or social group in mind?  
6. Does the site usually dictate the price range of the housing?  
7. Do you usually locate near (1) or avoid locating near (2) other new housing developments?  
8. Do you usually lead or follow other developments in making housing available in new areas?  
   (1) lead  
   (2) follow  

III. The section deals with the type of housing constructed.  
1. Which housing types has your company developed?  
   A. Single family houses  
   B. Garden Apartments and/or Condominiums  
   C. Row housing  
   D. Low-rise multiple  
   E. High-rise multiple  
   (Interviewer: indicate (1) yes, (2) no)  
2. Which of these types do you prefer?  
   (1) Single family houses  
   (2) Garden apartments and/or condominiums  
   (3) Row housing  
   (4) Low-rise multiple  
   (5) High-rise multiple  
3. Which types are you likely to build in the future  
   (1) Single family houses  
   (2) Garden apartment and/or condominiums  
   (3) Row housing  
   (4) Low-rise multiple  
   (5) High-rise multiple  
   (Interviewer: indicate (1) yes, (2) no)  
4. Have you found any municipal or legal constraints against the type of housing you have built in the past?  
   (1) yes  
   (2) no
5. If yes, please specify

   (a) type of constraint

   (1) building code restrictions
   (2) difficulty in obtaining building permit
   (3) zoning restrictions
   (4) other (please specify)

   (b) type of housing

   (1) Single family houses
   (2) Garden Apartment and/or Condominiums
   (3) Row housing
   (4) Low-rise multiple
   (5) High-rise multiple

   (c) municipality

   (to be coded later)

6. If yes, has this been a deterrent to building more of these units in the future?

   (1) Yes
   (2) No

7. (Interviewer: hand respondent Card A)

   Would you please tell me the income group that you aimed your multiple family housing to, by giving me the appropriate letter code?

8. and for single family housing?

9. Which of the following factors determine the number of bedrooms in the housing units you build?

   (1) Prevailing style in surrounding areas
   (2) Family structure in surrounding areas
   (3) Age structure of population
   (4) Construction costs
   (5) Other (please specify)

   (Interviewer: indicate (1) yes, (2) no)
10. Which of the following factors determine the spaciousness of your housing units?

(1) Prevailing style in surrounding areas
(2) Income information on regional population
(3) Age structure of regional population
(4) Construction costs
(5) Land costs
(6) Other please specify

11. Which of the following factors determine the inclusion of such amenities as underground wiring, cul de sacs, paved lanes, play areas, or formal gardens.

(1) Prevailing style in surrounding areas
(2) Zoning regulations
(3) Other building or municipal codes
(4) other (please specify)

12. Which of the following factors determine the inclusion of such amenities as finished basements, extra family rooms, laundry rooms, or drapes and carpets?

(1) Prevailing style in surrounding areas
(2) Income information on regional population
(3) Age structure of regional population
(4) Family structure of regional population
(5) Construction Costs
(6) Upon request only
(7) Other (please specify)

13. Do you plan for families with children, families without children and for single individuals in developments of

(1) Single family houses
(2) Garden Apartments and/or Condominiums
(3) Row housing
(4) Low-rise multiple
(5) High-rise multiple

(Interviewer: indicate (0) don't do this type of housing
(1) Yes
(2) No)
IV  This section deals with aspects of renewal and redevelopment.

1. Have you found it necessary in most cases to acquire more than one parcel of land for developments of
   (1) Single family housing
   (2) Multiple family housing
   (Interviewer: indicate (1) yes (2) no).

2. Of the parcels that you acquire for single family housing, what percentage are
   (1) vacant
   (2) occupied by single family housing

3. Of the parcels that you acquire for multiple family housing, what percentage are
   (1) vacant
   (2) single family housing

4. What percentage of the single family housing is in
   (1) poor condition
   (2) average condition
   (3) good condition

5. Has any project of yours been discontinued because of difficulties
   (1) in assembling land?
   (2) in obtaining the proper zoning?
   (Interviewer: indicate (1) yes, (2) no).

V.  This next section deals with the effectiveness of government controls.

1. I will read you a list of government and public organizations involved in planning and controlling land use. Would you tell me please how often you are involved with them by responding
   (0) never
   (1) sometimes
   (2) often
   (3) Always
A. Planning Department
B. Permit and License Department
C. City council
D. Assessor
E. School Board
F. Parks Board
G. Ratepayer's Associations
H. Engineering Department
I. Regional Planning Board
J. Other (please specify)

2. Is citizen acceptance of your proposal an important element in your decision to proceed? (1) yes (2) no

3. Do residents of the immediate surrounding area significantly affect the character and type of development you will build? (1) yes (2) no

4. Do you follow a specific list of steps in gaining governmental approval of your development? (1) yes (2) no

5. If you do follow such a procedure, could you please specify the steps in the order in which you follow them.

STEP

This final area of concern deals with financing.

1. Do you usually use options for land purchases? (1) yes (2) no
2. How long is the option period typically?
   (1) lender 30 days
   (2) 31-60 days
   (3) 60-90 days
   (4) 91-120 days
   (5) 121-180 days
   (6) 181-270 days
   (7) 271-365 days
   (8) greater than 1 year

3. Do you often pay for options in advance? (1) yes
   (2) no

4. Do you usually include the option as an element in the purchase price should you exercise the option?
   (1) yes
   (2) no

5. Which is the most critical period for financing a housing development?
   (1) purchase of land
   (2) construction financing
   (3) financing inventory of completed units
   (4) other (please specify)

6. In which area do you place most effort in order to reduce your costs?
   (1) Land cost and land assembly
   (2) Servicing
   (3) Construction-Labor
   (4) Construction-materials
   (5) Sales
   (6) Financing

7. I will read you a list of financial sources. Would you please tell me for each how often you use the source by responding
   (0) never
   (1) sometimes
   (2) often
   (3) always
   (Interviewer: record number of response)
A. Institutions (Pensions, Trusts, etc)  48
B. Insurance Companies  49
C. Banks  50
D. CMHC-NHA  51
E. Equity  52
F. Mortgage Bankers  53
G. Partnership funds  54
H. Personal loans  55
I. Retained earnings  56
J. Personal Savings  57
K. Syndicated investors  58
L. Other (please specify)  59

8. With respect to the details of financing could you please tell me the degree of importance of the following factors by responding

(0) unimportant
(1) fairly important
(2) average importance
(3) very important

A. Rate of Interest  60
B. Term of Loan  61
C. Amortization period  62
D. Loan to Value ratio  63
E. Degree of participation in cash flow by lender  64
F. Other (please specify)  65

9. Thank you for your help. The information you have provided has been very helpful and will be kept in strict confidence. Would you like a copy of the survey results?

(1) yes
(2) no

Interviewer: be sure to record the name and address.

Name and Address

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________


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STAGES IN THE DEVELOPMENT PROCESS

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<td>C. CHOOSING SIZE OF DEVELOPMENT</td>
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<td>D. CHOOSING A SITE FOR THE DEVELOPMENT</td>
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<td></td>
<td>E. CHOOSING A NEIGHBOURHOOD FOR THE DEVELOPMENT</td>
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<td>F. CHOOSING A CONTRACTOR</td>
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<td>G. GETTING ZONING CHANGED (IF NEEDED)</td>
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<td>H. GETTING BUILDING PERMIT</td>
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<td>I. OTHER STAGES - PLEASE SPECIFY</td>
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"CARD A"

INCOMES RANGES OF PROSPECTIVE PURCHASERS

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