SPATIAL ASPECTS OF PROJECTED RESIDENTIAL EXPANSION CORVALLIS, OREGON

by

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ABSTRACT: The Corvallis "urban area" has been selected for the research problem at hand. Primary concern lies with forecasting a 1985 arrangement of single-family residences. A model is developed to simulate the 1968-1985 process of residential expansion outside of the present city limits. Results of the simulation are summarized both numerically and cartographically.

INTRODUCTION

Recent housing and population studies serve to indicate that Corvallis is a growing city, one with sizable potentials for community development. These local studies, however, seem to depend on the idea that numerical forecasts from past data and immediate trends are an end in themselves, which is to say, adequate expressions of the community's growth potential. It is the writer's contention that this is not so, that this is only an initial step, and that a more useful illustration--once the basic estimate has been obtained--can be developed through such techniques as model-building and Monte Carlo simulation.

In essence, this research problem is then a spatial consideration, that is, it deals with the arrangement and location of real world phenomena in an areal, space-consuming sense. Like a small boy selecting from a set of alphabet blocks, it takes certain attributes of this spatially-distributed phenomenon, and places them into a framework. In this particular case, the framework is a model.

> A model is an abstraction of a given situation and consists of a representation of its essential characteristics in the form of carefully selected data.[1]

More precisely, the framework is a simulation or probability type of model.[2] The object of developing such a model here is to aid the writer in representing Corvallis' residential expansion process. It is to be used with the intention of forecasting a spatial arrangement of new residences outside of the city limits some seventeen years hence. Among the major inputs of this model are the following items:

1. an estimate, or projection of the numerical increase in new residences between 1968 and 1985.

2. a set of restrictions, which channels the spread of new residences only into those areas felt suitable for residential development.

3. a direction-prompting element, which suggests a choice between different "unrestricted" areas surrounding Corvallis to the projected stock of households.

4. a distance component, which offers the prospective residences a choice as to proximity of the city proper.

5. a randomizing, or chance effect, which tends to account for possible discrepancies in the household decision-making.

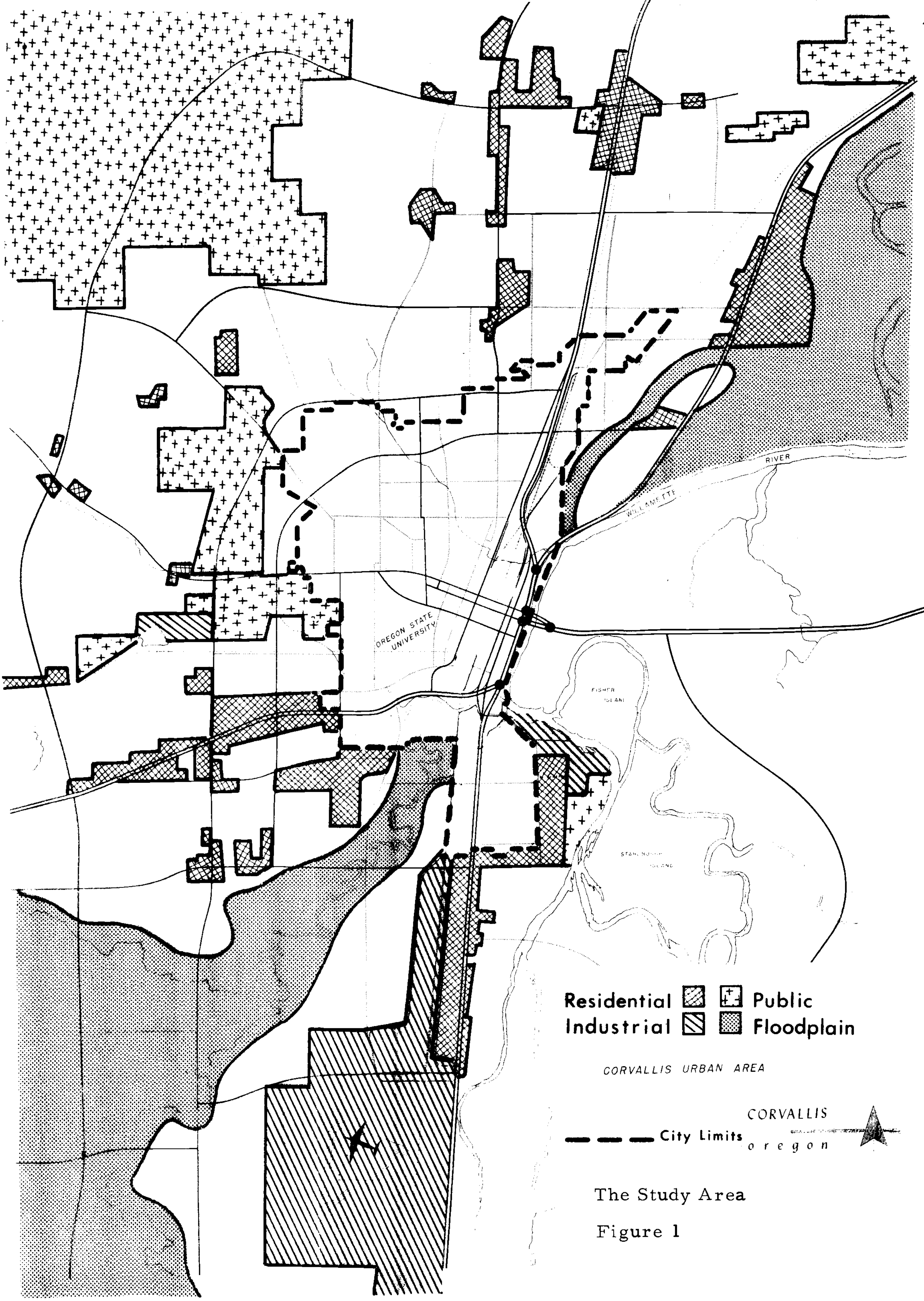
There will be many spatial characteristics reflected in the simulated distribution, but the crucial feature to be captured in this 1985 setting is that of pattern--an inherent aspect of any geographical, or spatial consideration.[3]

The basic format of the paper revolves around four main parts: first, the general setting of the study area is discussed; second, the model's first input, the projection of new residences is established; third, the expansion model itself is developed; and finally, the simulated location of the projected increase is presented.

PART I - GENERAL SETTING

Specifically, the area under study is the Corvallis "urban area" as defined cartographically by the local planning commission in the comprehensive plan (Figure 1).[4] This confines attention to some 3-4 miles on each side of the present city limits. Coverage includes the small unincorporated community of Lewisburg to the north and the Corvallis Municipal Airport to the south. Eastern and western boundaries are respectively set by the Willamette River and the halfway point between Corvallis and Philomath. The study area essentially represents the areal range of City Hall's jurisdiction over subdivision procedures.

Generalized population studies for the study area assign it an approximate total of 38,350.[5] The greater share of this total is contained within the city limits of Corvallis with some 30,680 inhabitants.[6] The area has direct access to Interstate 5, the major expressway in the Willamette Valley. U.S. 99W, a parallel route, passes through the city's centeral business district, and U.S. 20



The Study Area

Figure 1

connects with Newport and the coastal area some 60 miles away. A substantial amount of the area's economy revolves around Oregon State University. This university and university-oriented research and development is expected to significantly contribute to the area's future growth.[7]

As shown in Figure 1, the bulk of the built-up area (mostly residential) is spatially concentrated in and around the periphery of the city proper. Except for a limited amount of urban renewal and private reconstruction within the present city limits, there is every indication that most of the community's future development will take place in this fringe area. Ample room has been provided in the outlying, essentially rural areas of the local plan to accommodate the inevitable outward movement of this periphery. This is regardless of the amount or intensity that development could be expected to assume in the next seventeen years.

Since the enactment of the comprehensive plan (1964), there has been talk of implementing an agricultural and floodplain zoning ordinance in an attempt to prevent most further subdivision encroachment. The simulation of residential growth in Part IV of this paper is made under the assumption that this proposed move is successful.

PART II - PROJECTION OF NEW RESIDENCES

As typical of most small or medium-sized cities, the standard procedure for estimating future growth potentials in the Corvallis area has been through graphic and ratio extrapolation of existing data trends. In order to reach an approximation of the number of newly-constructed residences between now and 1985, it is necessary to rely on such methods. The tentative projection derived here is to be considered as one of the major inputs of the expansion model, which is discussed in Part III. For the time-being, however, concern lies with establishing a rational, up-to-date judgement about the future level of household building activities in the study area.

The data for this basic estimate was made available through the services of the Corvallis Public Works Office[8] and the Center For Population Research And Census at Portland State College in Portland, Oregon.[9] A dual-phase forecasting operation was then attempted. This consisted of (1) a time-series extrapolation and (2) a time-series correlation analysis (as a check upon the first method).

Time-Series Extrapolation

The initial phase involved a graphic extrapolation of past residential building activities. Very briefly, it entailed (1) plotting yearly residential construction figures against time (1940-1967),

(2) fitting a trend line by least squares, (3) extending this line to the forecast date (1985), and (4) accumulating the Y-values, or estimates, which correspond to respective points, or years, along the X-axis.[10]

Because of some sharp breaks in the data pattern (Figure 2), it seemed unlikely that any one extrapolation could yield a reliable forecast of future home-building activities.[11] When the foregoing procedure was used on both a long-term (1940-1967) and a short-term (1956-1967) basis, an expected high-low discrepancy became obvious. The respective estimates from each of these two extrapolations were a high of 3,928 and a low of 3,426 residences by the year 1985. In light of this disagreement and the past data fluctuations, it was felt that neither projection could be accepted as being indicative of the actual trend. The writer then established a set of estimates extending in intermediate fashion (i.e., along the geometric center of the angle formed by the two extrapolations). This intermediate projection, which resulted in an estimate of 3,641 new households, did in fact seem to be the "most feasible" out of the three attempts.

The pitfalls of this rather arbitrary or pragmatic selection, however, were recognized. Final judgement on the matter was reserved until further insight was available.

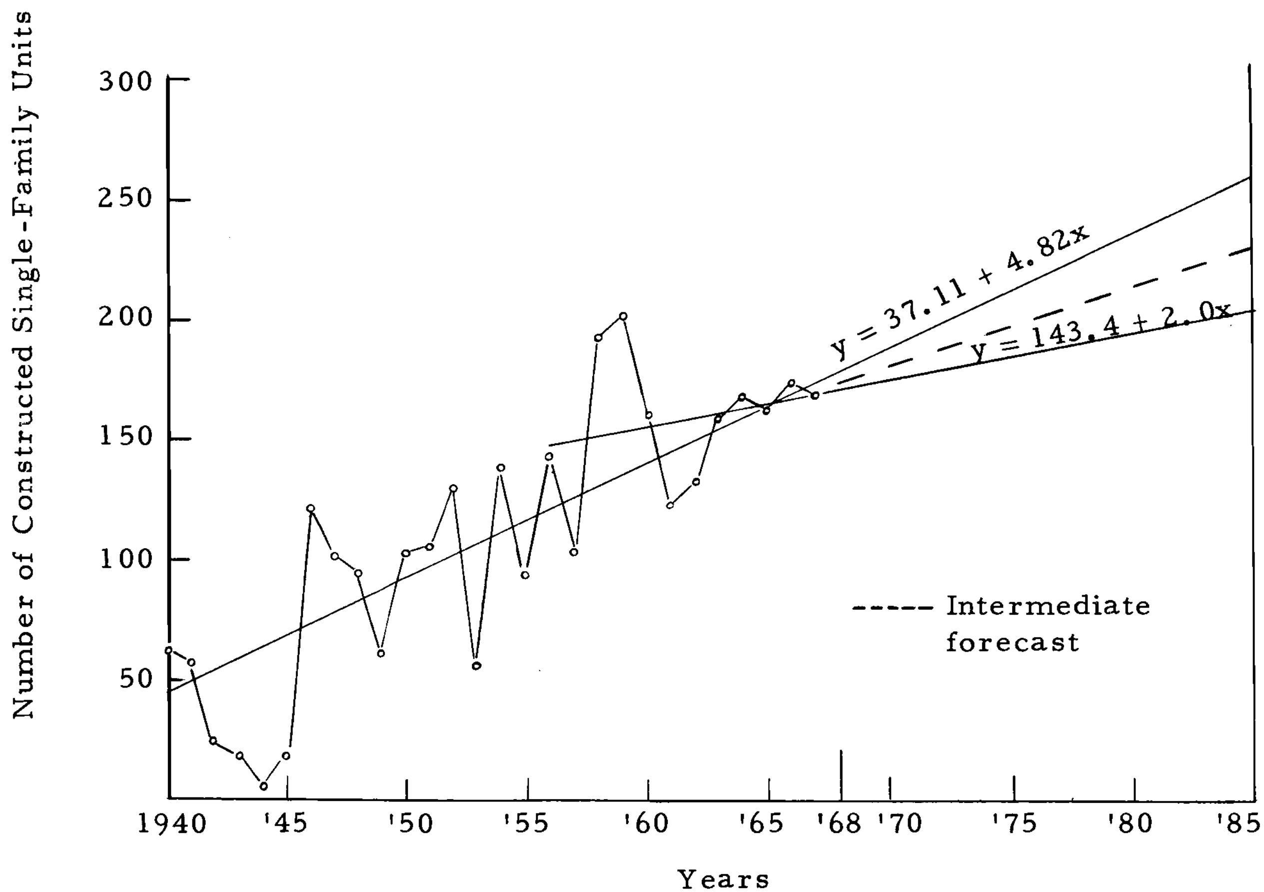


Figure 2. Time Series Extrapolation.

Time-Series Correlation

Basically, the next phase of this forecasting operation revolved around the notion that home construction is directly associated with population growth--i.e., there are so many single-family residences built for every increment of population increase. It was felt that if this relationship could be established as being statistically significant (via regression-correlation analysis), then a legitimate basis would be provided for determining whether the intermediate projection was commensurate with the expected numerical increase in population.

At first, the relationship seemed non-existent (Figure 3). However, as building activities often lag behind a given increase in population, it was decided to substitute a 3-year moving average in place of the original dependent variable.[12] As a result of this adjustment, a strong association ($r = .71$) became readily apparent (Figure 4). This resultant r-value seemed to vindicate the use of a ratio-type of forecast in checking upon the plausibility of the intermediate set of estimates.[13]

Based on the regression line established in Figure 4, a ratio of 154 households for every 1000 increase in population was obtained. By applying this constant ratio against the estimated population increase (1968-1985), and taking into account the lag between population

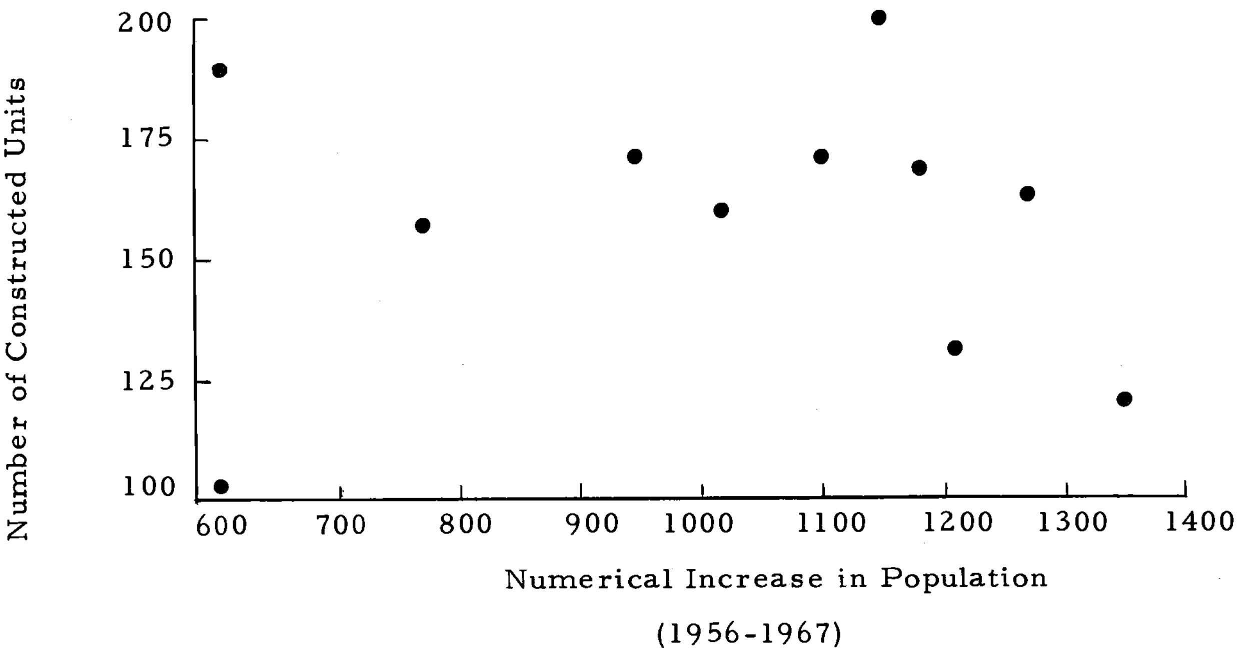
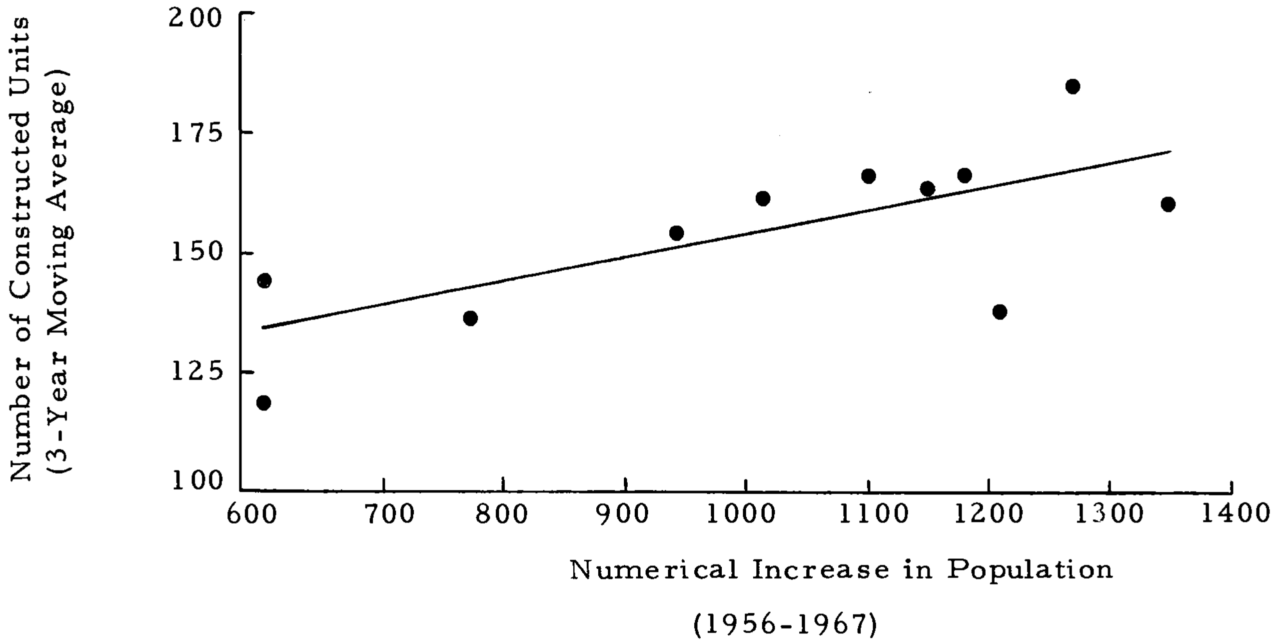


Figure 3. Relationships between home construction and population growth.



r = .71
(significant at the 5% level)

Figure 4. Relationship between home construction (3-year moving average) and population growth.

growth and completed construction, an estimate of some 3,656 residences by 1985 was established. This figure in fact formed very close agreement with the previously-derived 3,641 figure, thus justifying to an adequate extent the use of the intermediate forecast in the expansion model.

In capsule summary, the final projection is 3,641 new residences between 1968 and 1985. It is recognized that this projection is related to past criteria and assumed population totals. Its validity, therefore, depends upon the fulfillment of 1985 expectations and the maintenance of past residential growth trends.

At any rate, a reasonable approximation has been made. It should now be possible to attempt anticipating the spatial implications of this projected numerical increase in residences.

PART III - DEVELOPMENT OF AN EXPANSION MODEL

A simulation or probability approach to model-building has been elected to serve as the working basis, or operational framework, for determining a 1985 pattern of expansion within the study area. The main reason for using this procedure is that it provides the author with a means of reducing the complexities of a real world occurrence--here residential growth--to a simplified form.[14] Since the model at hand is to be only a simple expression of the growth process, it should be realized that some characteristics of interest, or perhaps even pertinance, may not have been included in its framework.[15] Certainly, however, every attempt was made to be as complete and as relevant as was felt possible.

In the hypothetical expansion process, it is first necessary to envision the model's basic unit, the individual house, in a decision-making role. This house is essentially searching outlying and unoccupied terrain in an attempt to establish itself. The manner in which this individual unit decides to locate includes alluding to measures of "locational possibility"--certain possibilities in the decision-making being a more probable or likely choice than others. These reference features, for all practical purposes, are felt to be either one of two types in the model: (1) a series of probability functions suggesting a choice as to direction and (2) a series of probability functions offering a distance consideration. Both features are thought of here as being locational indices, that is, location-prompting measures comprised of several different factors responsible for residential dispersal.[16] Their specific function in the model is to provide each and every prospective household in the projected total a choice as to future location.

The Underlying Constraints

At this point, certain restrictions must necessarily be placed upon the growth model.[17] These take the form of preconditions with respect to simulated expansion, and are initially set up as follows:

1) future residential development will be restricted to a density specification of 0 to 9 dwelling units per net residential acre (as suggested by the local planning commission in the comprehensive plan).

2) new residential growth will be limited to land other than that which is presently employed in urban usage, or is slated in the future for non-residential urban functions, such as industrial districts, public facilities, and outlying commercial centers.

3) land subject to flooding and land included in extensive ownership tracts (e.g., MacDonald Forest) will be eliminated from consideration.[18]

Several strong assumptions are inherent in the above pre-determined controls, but perhaps the most critical one is that the model assumes no change in the local plan. This is in addition to the zoning assumption mentioned earlier. Although future planning revisions will undoubtedly be made in both instances, the impracticalities of attempting to account for such adjustments in the model are obvious.

The Locational Indices

Given these initial constraints imposed upon the model's operational framework, the distributive arrangement of the projected residential increase is then based upon (1) an "attractiveness index" and (2) an "accessibility index". The main purpose of each index is to set up relative measures of locational possiblity, or household-receiving potential, for different "unrestricted areas" (i.e., not under constraint) around the Corvallis periphery. They are discussed here in the ordered sequence by which they are considered by each household in Part IV of this paper, the simulation stage.

An Attractiveness Index

According to a model of urban expansion put forth by Homer Hoyt, residential areas tend to extend outward along distinct radii--i.e., in sectors.[19] As a result of variance in the desirability of locating within any one sector, different types of residential areas tend to develop. Furthermore, on the outer rim of each sector, the character of new growth tends to become repetitive, with each new residential increment reflecting the essential character of earlier growth in that same sector. If Hoyt is correct in this notion of sectors and "sector continuity", then a useful approach to the establishment of a mechanism prompting directional movement in the study's developing growth model has been provided.

Zonal Boundries: The first step in designing the index was to find some means of segregating the unrestricted areas surrounding the Corvallis city proper into sectors, or zones as they are called here. Such a means seemed to be offered by the Corvallis Planning Commission in a recent housing study.[20] In this report, the city of Corvallis was divided into 14 neighborhoods. For the most part, these neighborhoods were delimited by "recognized boundries such as major streets or by a marked change in topography or land use".[21] With the study's ensuing inventory pointing out distinct differences in each neighborhood's residential character, it was felt that Hoyt's concepts could be applied in rough form. This was accomplished by selecting the eight outermost neighborhood areas, and extending their boundries into the "unrestricted" areas along major rural roads and other obvious physical features (Figure 5).

Definition: With the basic rationale and zonal framework established, it was necessary to concentrate on the component elements of the index itself. As applied in this paper, the "attractiveness index" is to represent a quantitative measure of potential attractiveness for any one of the eight outward-extending residential zones. Each zone is to be jointly conditioned by (1) its relative investment and/or development potential and (2) its respective level of existing neighborhood amenities.[22]

Through application of building permit data, it was possible to construct two serviceable proxies, one for each broadly-defined member of the index. Although limited in some respects, the selected proxies serve to function as a quantitative expression of the index's component features, and offer a more rigid means of deriving the zonal potentials than if the index was implemented otherwise. The proxies are as follows:

1) the relative number of new dwelling units for the last one and one-half years--as a proxy of investment and/or development

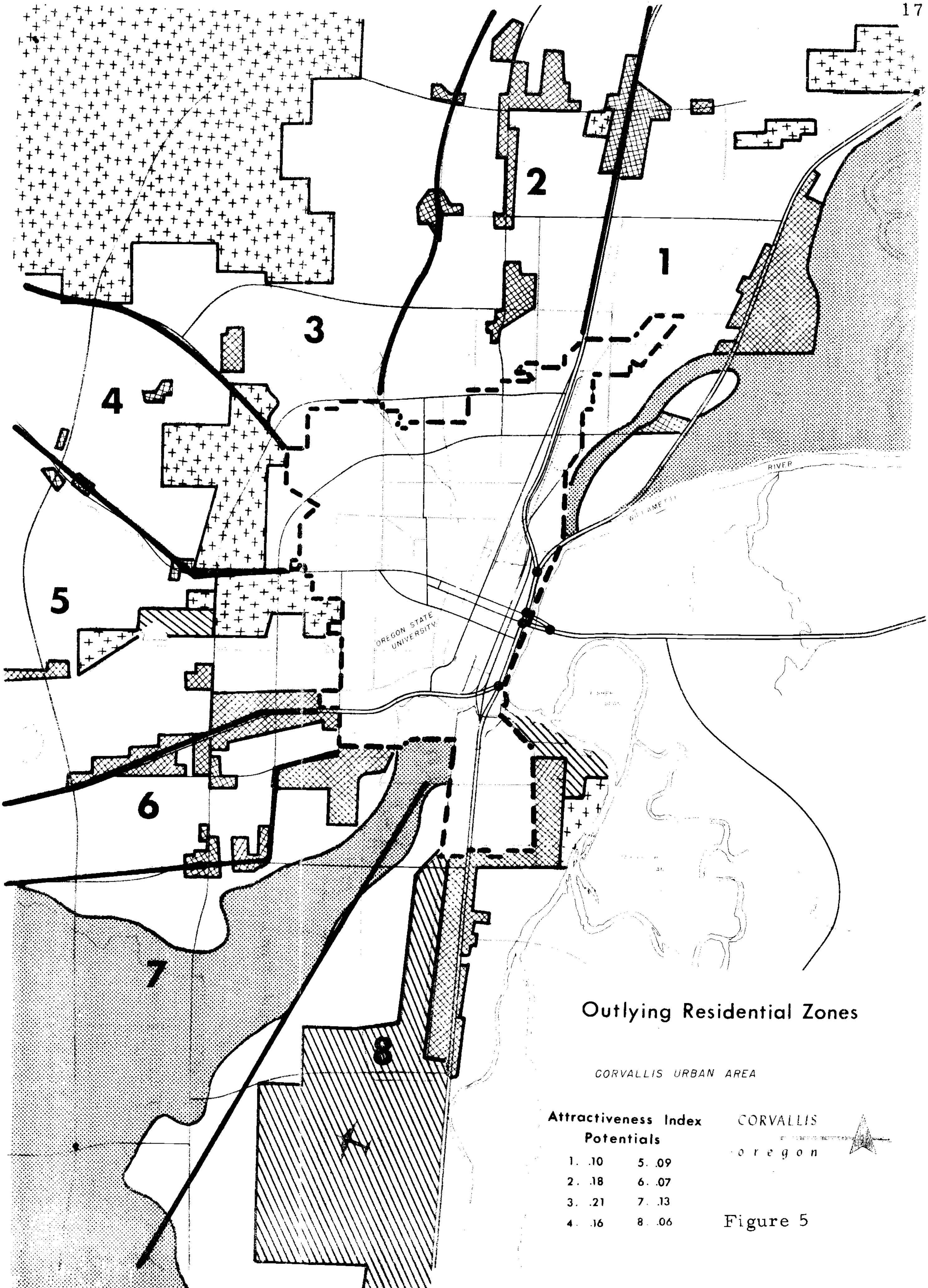

1
2
3
4
5
6
7
8
OREGON STATE UNIVERSITY
RIVER
Outlying Residential Zones
CORVALLIS URBAN AREA
CORVALLIS
oregon
Attractiveness Index Potentials
1. .10
2. .18
3. .21
4. .16
5. .09
6. .07
7. .13
8. .06

Figure 5

incentive on those unoccupied sites directly in line with a given rate of construction.

2) the average estimated cost of this new construction--as a reflection of existing and potential amenities (i.e., site quality, housing appearance, income level, and neighborhood status).

Hence, for each of the eight zones, a composite value of potential attractiveness may be obtained.

$$A_{1 \cdot i} = f_1 (nR_i + cR_i)^{-1}$$

where

$A_{1 \cdot i}$ = the potential attractiveness rating for any one zone.

nR_i = the rank score of proxy (1)

cR_i = the rank score of proxy (2)

Measurement: In order to derive the $A_{1 \cdot i}$ values, it was first necessary to plot the addresses of all newly-constructed residences (last year and one-half) with their respective construction costs on a small-scale map of the city. The addresses falling within the outlying, or fringe neighborhoods (the inner portion of each zone) totaled 224 in number. Once this simple, but time-consuming operation was completed, the number of residences in each zone was counted, and the mean estimated construction costs for each neighborhood was computed. In an effort to smooth the disruptive influence of exceptionally large subdivisions (for Corvallis), the proxy values for each zone were ranked. These ranked values were then combined to yield respective total scores. Table 1 illustrates the results:

Table 1. Preliminary Results of Zonal Measurement

Zone	Rate	Rank	Average Cost	Rank	Total Score
1	12/224	5	$13,625	2	7
2	118/224	8	14,310	4	12
3	44/224	7	20,750	7	14
4	18/224	6	20,611	6	12
5	10/224	4	14,200	3	7
6	8/224	2	15,812	5	7
7	5/224	1	31,400	8	9
8	9/224	3	11,888	1	4

Ties in several of the resulting figures were broken by weighting total scores of the zones in question by their relative amount of building deterioration and dilapidation.[23] The adjusted index ratings, which were then converted into the zonal potentials, or probabilities of attracting development, appear in Table 2:

Table 2. Conversion of Adjusted Scores to Zonal Probabilities

Zone	Adjusted Scores	Probability of Household Attraction
1	7	.10
2	12	.18
3	14	.21
4	11	.16
5	6	.09
6	5	.07
7	9	.13
8	4	.06
Total	68	1.00

These values were then filed for future reference--i.e., until the actual process of simulation.

An Accessibility Index

Most of Corvallis's intensive land uses are spatially located within one or more well-defined centers of the city proper. These centers represent focal points upon which a major volume of household trips converge (e.g., Oregon State University). It follows that in a loose sense they are the access loci for typically urban functions--complimentary functions which form the very cohesiveness and essence of the community's agglomeration. Hence, any model developed for simulating the distributive, or spatial arrangement of city-oriented households must acknowledge the importance of accessibility in some fashion or another.[24]

Intra-Zonal Boundries: Having established the zonal areas, the second step in continuing design of the expansion model was to subdivide each zone into a number of intra-zonal areas. It was felt that household considerations of distance, or accessibility could function as the differentiating basis for this step. From an excellent monograph, Factors Influencing Land Development, four especially relevant factors (out of fourteen identified as being statistically significant) were then applied to the notion of accessibility as developed in this paper.[25] These factors included: distance to work areas, distance to nearest elementary school, distance to nearest convenience shopping center, and distance to major streets and highways.

Definition: The preceding rationale and cited literature permits an attempt to define operationally the "accessibility index". The index refers here to a quantitative measure of accessibility between potential residential sites and complimentary forms of urban land use. Any one site's accessibility is an aggregate function of its travel-route proximity to the nearest focal points.

access loci:

1) the CBD--as a major commercial, cultural, and employment center.

2) Oregon State University--as a major employment center.

3) the nearest convenience shopping center--i.e., major supermarket or retail cluster offering food, drugs, and variety goods.

4) the nearest public elementary school.

The accessibility of the i^{th} site is then expressed in convenient notation as $A_{2 \cdot i} = f_1 (D1_i + D2_i + D3_i + D4_i)^{-1}$ where $A_{2 \cdot i}$ is the accessibility to urban focal points from a potential site, D1 is the travel-route distance to the CBD, D2 is the travel-route distance to OSU, D3 is the travel-route distance to the nearest convenience shopping area, and D4 is the travel-route distance to the nearest public elementary school.

Measurement: For purposes of the present study, it was necessary to limit attention to a sample of all potential sites within the designated area. A rectangular grid was constructed on a 2,140 foot module, and superimposed upon a map of the comprehensive plan.[26] Point-locations within each cell were selected for the samples. Some of these fell within the city, or other areas to which the model did not apply (i.e., restricted areas). These points were dropped from the sample, which was finally limited to a total of 236 intra-cellular locations.

The next phase of this operation was to derive the $A_{2 \cdot i}$ values for each point according to the accessibility equation, and then plot each of these index ratings with their respective positions on the overlay. Connecting points of equal value resulted in a series of "iso-access lines" radiating outward from the city limits. These isopleths of accessibility in effect segmented each residential zone into a number of intra-zonal areas. Relative measures of potential accessibility were then determined by the proportionate value of the midpoint rating within each intra-zonal segment, or area. These values in turn became the intra-zonal probabilities.

Table 3. Probability of Household Reception According to Accessibility Index

Intra-Zonal Areas	Accessibility Index Ratings	Probability of Household Reception
1	- 4.9	.31
2	5.0- 9.9	.19
3	10.0-14.9	.14
4	15.0-19.9	.10
5	20.0-24.9	.08
6	25.0-29.9	.07
7	30.0-34.9	.06
8	35.0-	.05

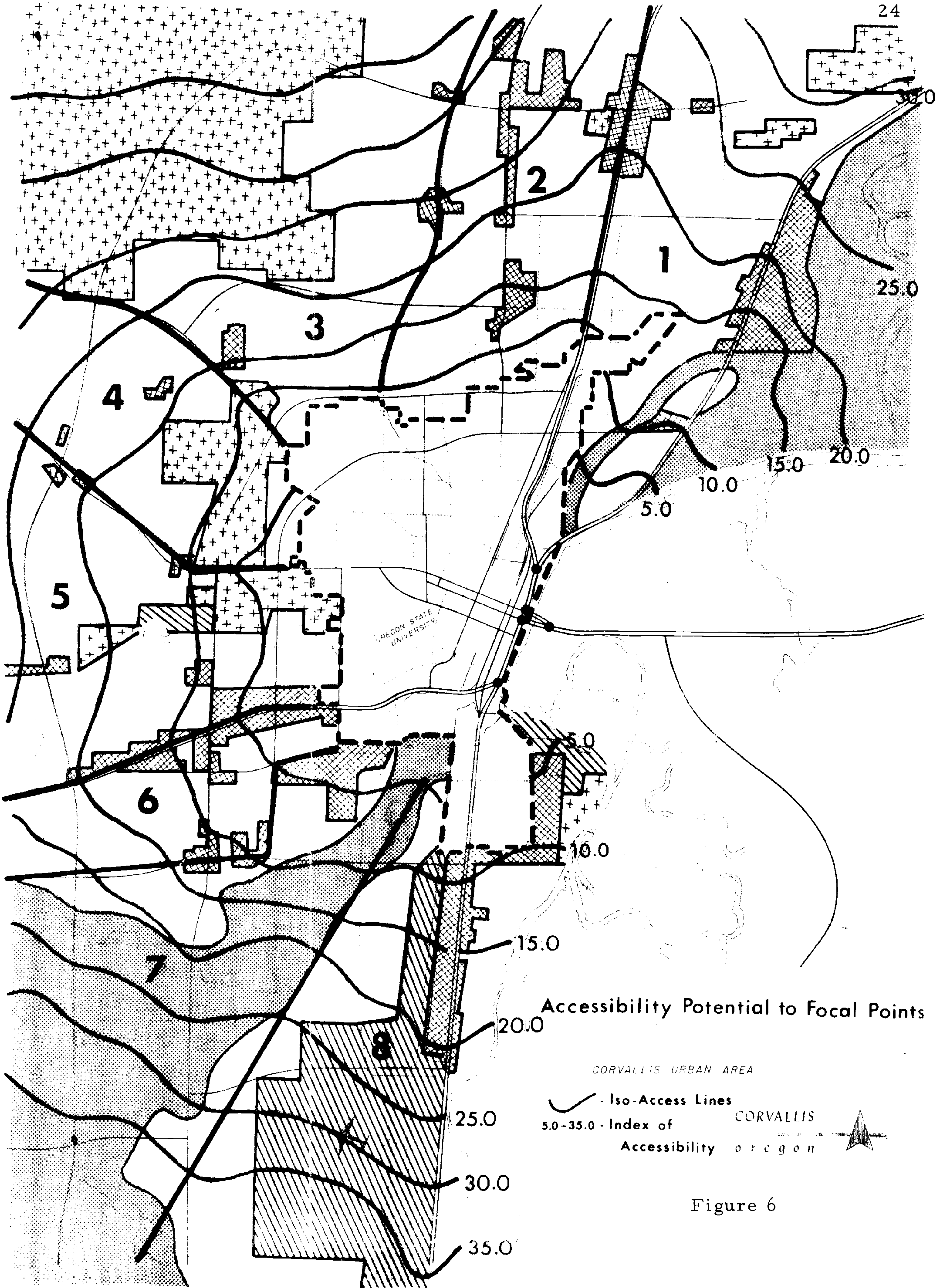
Figure 6 shows the spatial extent of potential accessibility as conceived in this paper.

PART IV - LOCATION OF PROJECTED RESIDENTIAL STOCK

The final stage of this research project was the random and sequential assignment of each new residence to the areas outlined by the locational indices. As the indices had already provided each zone and intra-zonal area with its own probability, or potential of receiving a given household, it was then simply a matter of attempting to satisfy those probabilities.

Step 1. Zonal Selection

The first step was to determine the number of new households which would be attracted to a particular residential zone. In line with Monte Carlo simulation procedures, the directional probabilities derived by the attractiveness index were converted into a range



1
2
3
4
5
6
7
8
5.0
10.0
15.0
20.0
25.0
30.0
35.0
OREGON STATE UNIVERSITY
Accessibility Potential to Focal Points
CORVALLIS URBAN AREA
- Iso-Access Lines
5.0-35.0 - Index of Accessibility
CORVALLIS
oregon

Figure 6

of discrete numbers.[27]

Table 4. Conversion of Zonal Probabilities to Discrete Numbers

Zone	Probability of Household Attraction	Equivalent Range of Numbers
1	.10	1-10
2	.18	11-28
3	.21	29-49
4	.16	50-65
5	.09	66-74
6	.07	75-81
7	.13	82-94
8	.06	95-00

Since the total numerical increase in residences is estimated to be 3,641, 364 random numbers (3,641/10) between 1 and 100 were drawn from the random numbers table.[28] As each of these numbers represents also a value in one of the zones (Table 4), the zonal destinations of the households are known. For example, if the random number 67 is drawn, then development will take place somewhere in Zone #5.

The use of the random numbers here tends to account for uncertainties in household awareness or reaction to these zonal and intra-zonal potentials. It is emphasized that this method does in fact differ from a sheer allotment procedure in that it offers a certain flexibility with respect to the model's decision-making. To be sure, the simulation will be notably affected by the differential weights, or values attached to the various zones and intra-zones, but owing to this effect of "randomness, or freedom of choice, a range of variability may be expected".[29] As a matter of illustrating this point, the resulting totals from the random generation may be compared with figures in which the procedure is a straight-forward allotment according to zonal potentials.

Table 5. Comparison of Simulated Totals to an Allotment Series

Zone		Probable Number of Households (Random)	Allotment Series
1		460	360
2		500	660
3		750	760
4		660	580
5		370	330
6		210	250
7		470	470
8		220	220
	Total	3640	3640

The results of this preliminary step are also summarized at the bottom of Table 7.

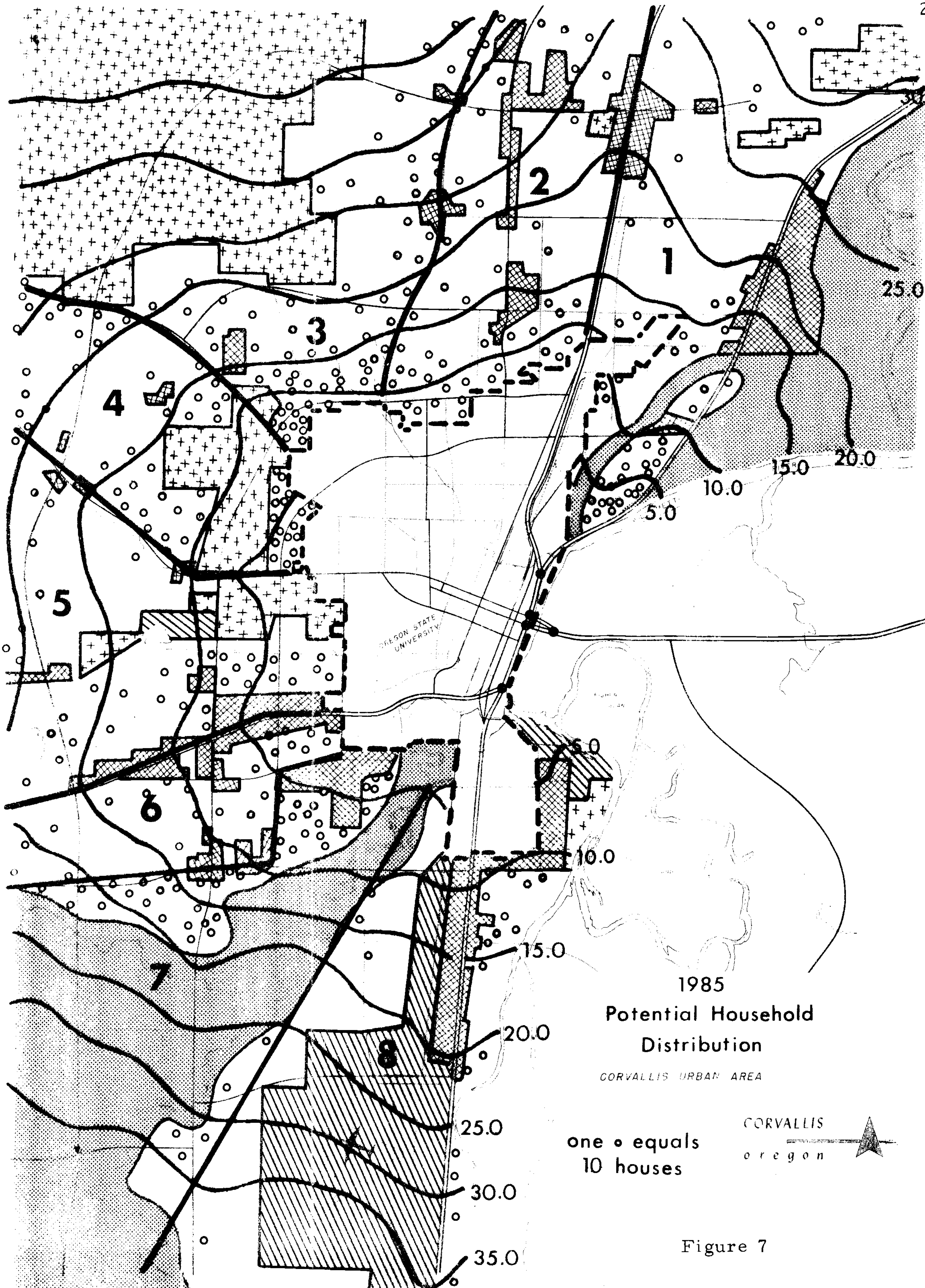
<u>Step 2. Intra-Zonal Location</u>

The projected household population assigned to each zone is then "forced" through a different set of probabilities in order to simulate the amount of intra-zonal development. These, of course, are the distance probabilities set up by the accessibility index. The same random selection process described in Step 1 is in effect repeated eight times, taking each zone in turn, but distributing the respective household totals according to the new probabilities. As an example, it may be recalled that 46 random numbers, or 460 households fell within Zone #1. Forty-six different random numbers were therefore re-selected, and applied to some corresponding value in Zone #1's intra-zonal areas.

Table 6. Conversion of Intra-Zonal Probabilities to Discrete Numbers

Intra-Zonal Areas	Probability of Household Reception	Equivalent Range of Numbers
1	.31	1-31
2	.19	32-50
3	.14	51-64
4	.10	65-74
5	.08	75-82
6	.07	83-89
7	.06	90-95
8	.05	96-00

The results of this second step, which terminates the simulation, are summarized in Figure 7 and in Table 7. In the cartographic summary, the dot distribution may be considered as being indicative of the 1985 spatial arrangement of residential land-use outside of the present city limits. Each of the 364 dots represent 10 new dwelling units. The location of this housing in clusters and along roads within the intra-zonal sections is due to the author's placement bias. Such a bias, however, does in fact seem to create a more realistic representation of growth than if the numerical results were located


1985
Potential Household
Distribution
CORVALLIS URBAN AREA
one ∘ equals
10 houses
CORVALLIS
oregon
OREGON STATE UNIVERSITY
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2
3
4
5
6
7
8
5.0
10.0
15.0
20.0
25.0
30.0
35.0

Figure 7

Table 7. Size-Distribution Summary of Simulated Residential Development Corvallis, Oregon 1968-1985

	Zones								
	1	2	3	4	5	6	7	8	
Intra-Zones									Total
1	150	100	170	200	70	70	130	80	970
2	90	80	130	80	90	40	110	30	650
3	100	80	140	100	70	60	60	20	630
4	50	60	80	50	30	0	80	20	370
5	10	40	90	70	40	20	40	20	330
6	10	70	80	40	10	10	20	20	260
7	20	40	40	80	20	0	30	10	240
8	30	30	20	40	40	10	0	20	190
Total	460	500	750	660	370	210	470	220	3640

in uniform fashion. In addition, whenever it appeared that an areal segment was approaching saturation (constraint #1), the remainder of the assigned stock was shifted into an adjacent segment of the same zone. Hence, it is felt that even in this respect the map is a better depiction of expansion than that suggested by the simulated totals--certain densities are being reached, and then simply spilling over into another, less-crowded area.

CONCLUSIONS

It would appear that the suggested approach to determination of the community's spatial potential has numerous applications. Both public and private interests seem to be represented. Certainly, those involved with planning and investment decisions would find it a useful consideration.

The simple growth model described here has incorporated many assumptions throughout its development. It relies partly on trend data and, hence, there are some obvious difficulties in anticipating a dynamic, every-changing situation. Secondly, and perhaps even more importantly, some relevant factors of possibly differing importance were included only indirectly or, because of data limitations, were omitted altogether.

It may be questioned whether models such as the one presented here can ever hope to simulate adequately the complex mechanism of the residential growth process. Yet the fact remains that with all its shortcomings and inherent weaknesses the model described did at least seem to generate a likely pattern of expansion for the particular study area. With due respect to a modest attempt, this is really all that could be expected.

FOOTNOTES

1. Preliminary Regional Plan For the San Francisco Bay Region, Association of Bay Area Governments; Berkeley, California, (1966), p. 50.

2. Richard, L. Morrill, "The Development of Spatial Distributions of Towns in Sweden: An Historical-Predictive Approach", Annals of the Association of American Geographers, Vol. 53, (March, 1963), p. 5.

3. John D. Nystuen, "Identification of Some Fundamental Spatial Concepts", in Brian J. L. Berry, Spatial Analysis, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, (1968), pp. 35-42.

4. Source: (Figure 1)
Corvallis City Planning Commission, Jay Otto: Director of Planning, Corvallis, Oregon (1964).

5. Population Trends (1960-1985): Corvallis-Philomath Urban Area, A report prepared by the University of Oregon Bureau of Municipal Research and Service for use in the Corvallis Transportation Study of 1965. (1967).

6. Population Estimates of Counties and Incorporated Cities of Oregon, July 1, 1967, Center For Population Research and Census, Portland State College; Portland, Oregon (December, 1967).

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