AN ABSTRACT OF THE THESIS OF

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Title: SELECTED VARIABLES INFLUENCING VACANT URBAN LAND IN CORVALLIS, OREGON

Abstract approved [redacted]
Dr. Ray M. Northam

The thesis presented here is a quantitative study of vacant urban land in Corvallis, Oregon. In order to present this study the writer first studied the available literature and found that little had been published dealing with causal factors of vacant urban land. Rather, it was found that several writers had mentioned vacant urban land in various studies, but few had studied it from a causal standpoint.

In light of this finding, the writer developed a linear equation and selected several spatial variables in order to attempt to express, quantitatively, what factors might influence the amount and distribution of vacant urban land in Corvallis. To accomplish the purpose of the equation a grid system consisting of thirty acre squares was superimposed over a base map of Corvallis that contained the actual distribution of the vacant parcels within the city area. The focal

point of the grid was the highest value corner of the central business district.

The grid system enabled the writer to develop the initial variables into two dependent variables and five independent variables. The dependent variables were based on the vacant parcels directly. The independent variables were based on the factors that would, it was felt, best explain the amount and distribution of the vacant urban land.

Having accomplished this purpose, the variables were analyzed by a computer utilizing standard multivariate statistical techniques. From an analysis of the data the writer was able to examine the role of each variable selected in explaining the amount and distribution of the vacant urban land in Corvallis, Oregon.

Selected Variables Influencing Vacant Urban
Land in Corvallis, Oregon

by

James Montgomery Meade

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SELECTED VARIABLES INFLUENCING VACANT URBAN LAND IN CORVALLIS, OREGON

INTRODUCTION

Vacant urban land is a factor mentioned in almost all the literature related to urban studies. Yet, beyond casual mention, little has been done to explain why the land remains vacant. When one asks persons in the planning profession why the land is vacant they often give vague answers (32). In fact, they do not appear to know exactly why the land is vacant and the vague answers given are little better than none. Basically however, the reasons given may be divided into two sets: 1) physical variables, and 2) economic variables.

As urban places continue to grow at rapid rates, both in population and areal extent, there is an increase of the amount of land they absorb. Often this growth is haphazard, manifesting itself in a series of leapfrogging stages from a relatively compact concentration of population to somewhat distant outlying nodes. The main effects of this growth pattern are: 1) areal expansion of the urban place into outlying regions, and 2) conversion of land in the area between the central concentration and the outlying node from its original uses to a form of quasi-urban uses. A quasi-urban use is defined here as a form of land use, almost urban but still rural in form or a land area in a period of transition from rural uses to urban uses. The idea presented here is that, due to land speculation in this area, farming is no longer the dominant use, but on the other hand neither are urban uses dominant, because the area is in a state of flux between the two uses and neither is dominant. As time passes and as the central concentration and the outlier continue to grow they fill in the quasi-urban area between them with urban settlement. Often, depending on the distance between the two, this filling-in process may require a considerable period of time.

It is the contention of this writer that this form of growth is an inefficient use of one of our most valuable resources, land. An inefficient use of the land, as it is referred to in this thesis, is the manifestation of land speculation in developing urban areas, which at times seriously inhibits both urban growth or continued rural uses such as agriculture. It is the contention of this writer that serious consequences can result from the inefficient use of our land resource. For instance, if the land remains in a prolonged state of vacancy, it might revert back to public ownership because of an inability of the owner to pay taxes, thereby increasing the tax burden of others. Also, if services to the area in transition have been provided by the city and they are not being fully utilized, it means that the taxpayer is out even more money with no positive results. Finally, if this area is bypassed by the city in its growth, that is if the city expands around the area and forms an enclave, the area might become a blighted area. If so, the area might begin to depreciate property values in adjacent areas. As such, at least from a financial standpoint, it behooves people to use the land resource as wisely as possible. The point the writer wishes to be made here is that people should begin to wonder why land is vacant and what factors are associated with vacant land that keep it in a state of vacancy.

Following a search of the literature, it has been found that little has been published that deals with the matter of vacant urban land.

Therefore, it is the desire of this writer to approach the problem of vacant urban land from a geographical standpoint and to examine possible underlying factors associated with its existence and distribution.

Review of Literature

As stated, there is a lack of published work that has dealt specifically with causal factors of vacant urban land. Rather, most of the articles deal with the distribution of vacant land or the effects of land vacancies on an area's economy. To the best of this writer's knowledge only one article has been written on causal factors as they relate specifically to vacant urban land.

Most of the early articles written mentioning vacant urban land give the matter only cursory attention and then focus on some other aspect of city growth. In one such article, entitled "A Diagnosis and Suggested Treatment of an Urban Community's Land Problem," the author, Edmund N. Bacon (2, p. 72), states that there were an estimated 30 million vacant lots in the United States in 1939. Bacon derived this data from a study of Flint, Michigan in 1939. He proceeds to explain that a large portion of the vacant lots were vacant because of tax delinquencies. He explains the tax delinquencies by showing that in many instances, whenever the city of Flint, Michigan experienced a pronounced period of land subdivision, large numbers of vacant lots were sold to marginal speculators who could afford to buy only a few vacant lots in expectation of a quick resale of the land and realization of a profit. This practice would have been successful were it not for the fact that in Flint, subdividing greatly exceeded the ultimate market for building lots. As a result, many of the lots were never sold and, as taxes owed on the lots increased, the marginal speculator was forced to let the land revert back to the city in order to pay the back taxes owed. The city of Flint, faced with the same problem of the marginal speculator, too much vacant land available, could not sell the land. Thus, it remained in a vacant state.

In another article written in 1949, entitled "Dead Land," Frederick T. Aschman focuses on "chronically tax delinquent lands in Cook County, Illinois" (1, p. 240). Aschman, like Bacon, does not focus on causal factors of vacant urban land. Rather, he goes into the effects of vacancies in dealing with tax delinquencies.

Clawson, Held, and Stoddard, in their book Land For the Future, state that "there is much idle land within city boundaries; studies of sample cities indicate that idle land averages one-third or more of the total. Some idle land available for expansion or new uses is desirable, but it appears that the amount now idle is far in excess of a reasonable amount and that great economies could be achieved in its better use" (9, p. 95). The point made here is that the authors at least recognize the problem.

The studies of sample cities referred to in the preceding paragraph might possibly be in a reference to a book entitled, Land Uses In American Cities, by Harland Bartholomew (3). Bartholomew points out that considerable vacant acreages exist in each of the thirty-three cities he studied. The following table indicates his findings:

Table 1. Percentages of Vacant Land in Selected Cities

Number of Cities	Population group	Vacant areas as a percentage of total city area
7	5,000 or less	60.51
6	5,000 - 10,000	42.78
10	10,000 - 25,000	37.77
10	25,000 and over	22.28

Source: Bartholomew, Harland. Land Uses in American Cities. Cambridge, Mass., Harvard University Press, 1955, p. 97.

As noted from the table, a higher percentage of vacant land is found in smaller cities. However, the point is that, although Bartholomew points out the fact that vacancies exist, he gives no concrete reason for the vacancies.

In another article, entitled "Recent Land Use Trends in Forty-Eight Large American Cities," John H. Niedercorn and Edward Hearle (23) study more recent changes in land use within a select group of American cities. Their study indicates the amount of vacant land within the cities studied is becoming less, but that efforts must be made to utilize the remaining vacant land even more effectively. They, like Bartholomew, also do not go into causal factors of vacant urban land. However, they do indicate that most of the vacant land within a city is found in close association with the city's periphery.

Such is the overall trend in most writings relating to urban land use. The fact that vacant parcels exist is accepted, but the reasons for their existence is a subject that is not adequately explored. However, one article and one statement have been found by the writer that deal specifically with the reasons for the existence of parcels of vacant urban land. These are "Factors Influencing Land Development," an article by F. Stuart Chapin Jr. and Shirley F. Weiss (8), and "Spatial Relationships and Potentials of Vacant Urban Land," a statement by Ray M. Northam (29).

The main article relating to this thesis is "Factors Influencing

Land Development," by Chapin and Weiss (8). In this article, the authors studied three cities in North Carolina; Lexington, Winston-Salem, and Greensboro. Their ultimate aim was to devise a forecast model which would measure how best to use land within an urban area. To accomplish this purpose they formulated a series of spatial variables and attempted to measure the effects of the selected variables on vacant parcels in the aforementioned three cities. It was of interest to this writer to see that Chapin and Weiss used variables similar to those used in this thesis. However, the study by Chapin and Weiss covers a much broader scope than that of this thesis. For instance, in the formulation of the variables this writer picked five independent variables, whereas Chapin and Weiss used fourteen. Also, in the initial analysis of the variables selected, different forms of measurement were used to express spatial relationships. This writer used distance measures exclusively, while Chapin and Weiss used both distance and economic factors such as assessed value of the vacant parcels and residential amenities.

Another writing that did influence, in a large way, the thesis presented here was a research proposal entitled "Spatial Relationships and Potentials of Vacant Urban Land," by Ray M. Northam (24), the writer's major professor. In this proposal Northam proposes to study two questions: "1) What spatially distributed variable factors are associated with the existence . . . of vacant urban land?

2) What potentials are offered by . . . vacant parcels in terms of accommodating urban growth?" As seen, the first factor mentioned encompasses the aim of this writer's thesis. Aside from the purpose, Northam's proposal and this thesis differ in many respects. For instance, Northam's proposal is much more involved and covers a larger area than the rather limited scope of this thesis. The main point to be made here is that the proposal made by Northam and the monograph by Chapin and Weiss at least indicate to the writer that study is being conducted on the factors associated with the distribution of vacant urban land.

Discussion of Terminology

Because of the scope of the problem it has been decided that certain definite parameters should be established wherein the problem could be examined most effectively.

First, it was decided that a working terminology be developed that is applicable to the problem. More specifically, clarification is needed as to what constitutes an urban area, what is urban land, and what is an acceptable definition of vacant urban land.

According to the 1960 Census of Population, a place is considered urban when its population reaches 2,500 (32, p. 19). The city of Corvallis, Oregon would fit this definition.

Ray M. Northam, has defined urban land formally as "land devoted to the conduct of activity in the secondary and tertiary sectors within an agglomerated settlement, and housing of population engaged in these activities" (25, p. 4).

Vacant urban land, therefore, must be land within the boundaries of an urban area. Opinions vary, however, as to what constitutes a parcel of vacant urban land.

In a reprinted article from his book Land Uses in American Cities, Harland Bartholomew (3, p. 13) defines vacant urban land as follows: "Vacant land is that not given over to any urban use even though it may be potentially available for development."

In another article entitled Decentralization And Blighted Vacant Land, Herman G. Berkman (4) makes no formal definition as to what constitutes vacant urban land. He does allude to it as land in a corporate city that for various reasons is left undeveloped.

Also, in another article by Edmund N. Bacon, "A Diagnosis And Suggested Treatment of an Urban Community's Land Problem," (2), the author covers the problem of vacant urban land in Flint, Michigan over a sixty-nine year period. Yet, Bacon, like Berkman, does not make a formalized definition of what constitutes vacant urban land. Rather, he alludes to vacant lots within the city's corporate boundaries.

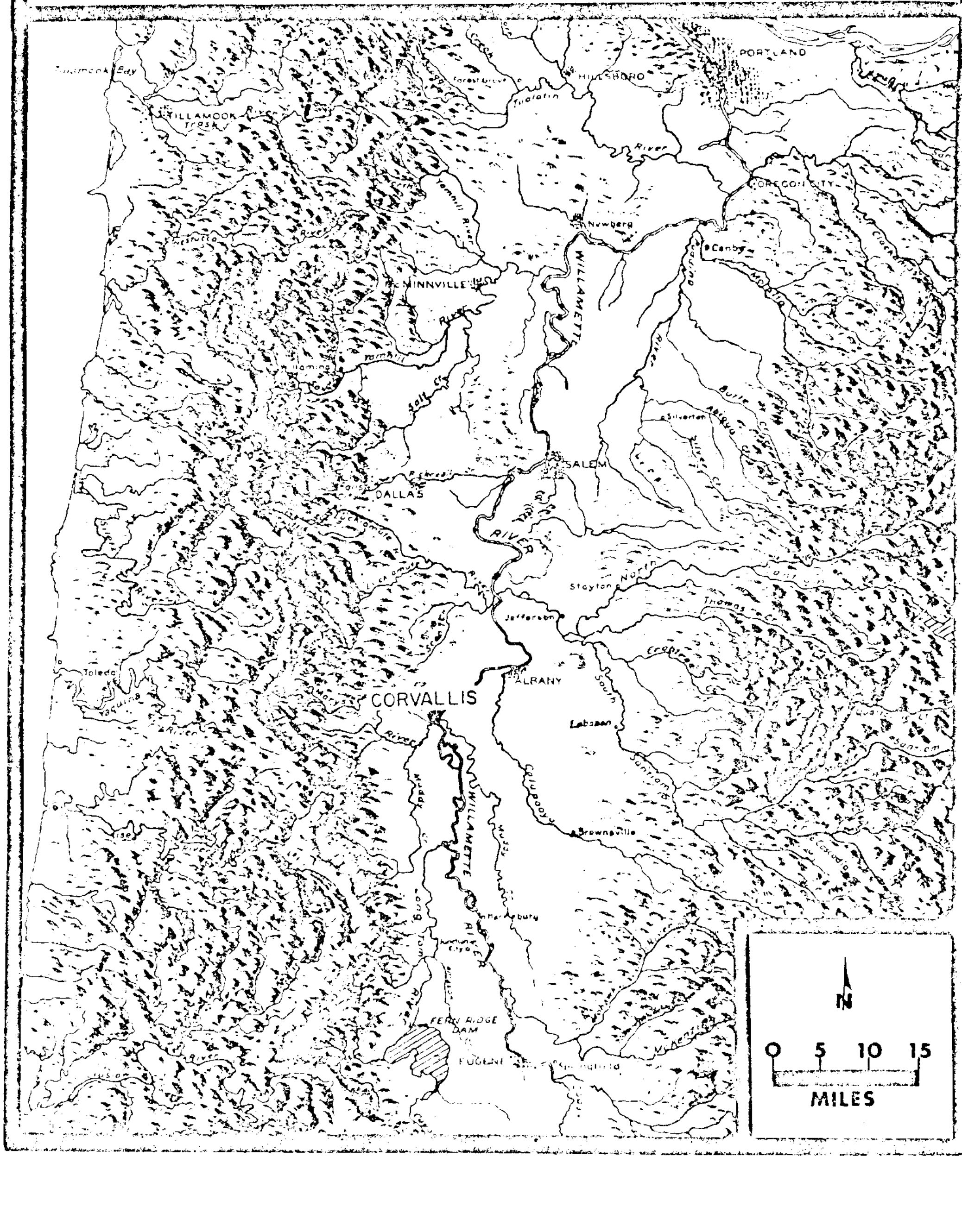
The most recent formal definition of vacant urban land was developed by Northam in a research proposal entitled Spatial Relationships And Potentials of Vacant Urban Land (25, p. 4). Northam formally defines vacant urban land as "land included within an agglomerated settlement but that is not devoted to a functional use characteristic of an agglomerated settlement."

Therefore, in light of the two general references and two formal definitions, the writer presents his definition of vacant urban land as it pertains to the city of Corvallis, Oregon. Land included within the corporate boundaries of the city of Corvallis that is not devoted to any functional use.

The reasons for the choice of Corvallis, Oregon as a study area were varied but include the following: 1) the writer is interested in the growth pattern of the city of Corvallis; 2) the area is easily accessible to the writer; 3) the writer has resided in the city for a period of seven years and is familiar with its environs and people; and 4) records in the office of the Corvallis City Planning Commission concerning a land use survey of Corvallis in 1964 have been made available to the writer. These, then, all went into influencing the writer's choice as to an area for study. After the selection of the study area, a question remained as to the accuracy of the records of the Corvallis City Planning Commission. The decision was made to use the material with some modifications. First, blank base maps were obtained, the same size and scale as those used in the 1964 land survey. Next, each parcel designated as vacant on the survey map was indicated on the base map. When all the map data had been collected, the maps were assembled and the boundaries of the study area were drawn. The final step in preparation of the map was to field check each parcel designated as vacant on the base map to make sure it was actually vacant. This step was accomplished by driving every street in the study area, observing each block for additions or deletions of parcels of vacant land.

Map One has been added to the thesis in order to acquaint the readers with the Corvallis area and its spatial relationship to western Oregon.

CORVALLIS AND VICINITY



SPATIAL VARIABLES: METHODOLOGY AND HYPOTHESES

As implied in the introduction, the study area was to be examined to determine the role of selected factors associated with the existence and distribution of vacant urban land.

Two avenues of exploration seemed open. One was an interview method; the other was by the use of a form of quantitative methodology.

In the interview method the owner of each vacant parcel of land would be interviewed by the writer. However, it was decided that this left several aspects open to question. For instance, this presupposes that the owners could all be contacted and would provide information to the writer. Also, it presupposes that the owners know why their land is vacant. It is not inconceivable that they would not actually know. Therefore, for these two reasons it was decided to use another means of approaching the problem.

The other means left open was the use of a form of quantitative methodology. Having reached this decision, the next objective was to select variables 1) thought to be significant; 2) of a geographic nature; and 3) capable of being treated quantitatively. As stated beforehand, two broad groups of causes of vacant urban land may be given; 1) those of a spatial nature, and 2) those of an economic nature. It was decided at the outset that the study of economic reasons would not be pursued because of the scope of the problem involved; therefore, only spatial reasons would be investigated. After considerable thought, it was decided that four spatial variables and one physical variable should be formulated and tested.

The variables selected for study are as follows:

1. Distance from the highest value corner of the central business district to the nearest boundary of the vacant parcel.
2. Distance from the vacant parcel to the nearest boundary of an unlike municipal zone.
3. Distance from the vacant parcel to the nearest major arterial having a traffic volume of at least 5000 vehicle movements per day.
4. Distance from the vacant parcel to the nearest public utility such as natural gas, electricity, water, and sewage lines.
5. The physical limitations offered by the vacant parcels, such as shape of the parcel, which might be a factor in keeping the parcel vacant.

Distance to Central Business District: (X_1)

Distance from the highest value corner of the central business district to the nearest boundary of the vacant parcel was the first variable picked by the writer. The writer's decisions as to the use of this variable were influenced by the articles he read concerning land use and the central business district.

Initially, it was thought that distance measurements would be made by measuring route distance. However, after it became apparent that the number of vacant lots would reach an unwieldly total, thus necessitating a large number of measurements, the idea of route distance was dropped and an alternate method sought.

It was found by the use of three random samples, each taken in different sections of Corvallis, that route distance is correlated closely to straight line distance with no great difference between the two. The method used to reach this conclusion was Pearson's Product Moment Coefficient Correlation (16, p. 469).

$$r = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2]\,[N\Sigma Y^2 - (\Sigma Y)^2]}}$$

Where:

N = Twenty (20), the number of vacant lots in each sample.

X = measure of route distance, to a tenth of a mile, from the highest value corner of the central business district to the nearest part of the vacant parcel.

Y = measure of straight line distance, to a tenth of a mile, from the highest value corner of the central business district to the nearest part of the vacant parcel.

r = the correlation coefficient between X and Y.

The results obtained for the three sample areas are as follows:

1. Area #1 - South Corvallis .86
2. Area #2 - West Corvallis .73
3. Area #3 - North Corvallis .99

From the results of the preceeding analysis a decision was made to use straight line distance measurement because, as the r values indicate, there is a high degree of correlation between route distance and straight line distance in Corvallis, Oregon. For purposes of measurement, the highest assessed value corner of the central business district was picked as a point of origin from which all measurements to the various vacant parcels would originate.

It is the hypothesis of this writer that as distance outward from the intersection of the corner with the highest assessed value of the central business district increases, the number of vacant parcels will increase. As stated, the writer's conclusions as to the use of this variable were influenced by the articles he has read concerning land use and the central business district. Also, in the formation of the base map it appeared that the number of vacant parcels increases as does distance from the central business district.

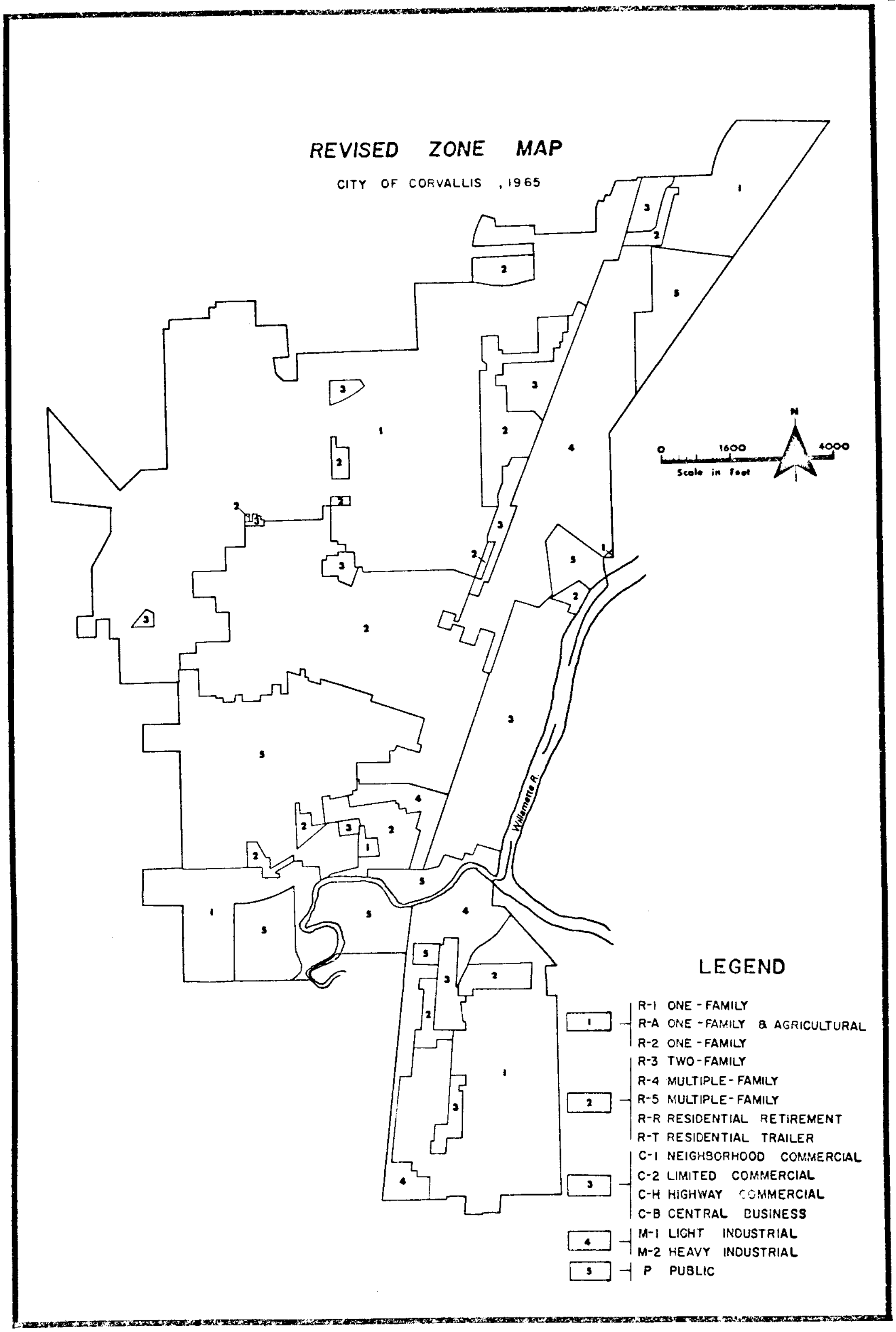
Distance to the Nearest Unlike Municipal Zone: (X_2)

Distance from each vacant parcel to the boundary of the nearest unlike municipal zone was a second variable chosen. The reason behind this selection was the writer felt that as distance from an unlike municipal zone increased, real or anticipated land use conflicts would be reduced, and there would be fewer vacant parcels. In order to express the relationship of distance from a vacant parcel to the nearest unlike municipal zone more easily, the fifteen different zone types established by the city of Corvallis were grouped into five classes. These were:

Table 2. Revised Municipal Zones, Corvallis, Oregon, 1966*

Revised Zones	Actual Zones	
1	R - 1	One-family.
	R - A	One-family and agricultural
	R - 2	One-family.
2	R - 3	Two-family.
	R - 4	Multiple-family.
	R - 5	Multiple-family.
	R - R	Residential retirement.
	R - T	Residential trailer.
3	C - 1	Neighborhood commercial.
	C - 2	Limited commercial.
	C - H	Highway commercial
	C - B	Central business
4	M - 1	Light industrial.
	M - 2	Heavy industrial.
5	P -	Public.

*See zoning map on page 18.


REVISED ZONE MAP
CITY OF CORVALLIS , 1965
0
1600
4000
Scale in Feet
N
Willamette R.
LEGEND
1 R-1 ONE - FAMILY
R-A ONE - FAMILY & AGRICULTURAL
R-2 ONE - FAMILY
2 R-3 TWO - FAMILY
R-4 MULTIPLE - FAMILY
R-5 MULTIPLE - FAMILY
R-R RESIDENTIAL RETIREMENT
R-T RESIDENTIAL TRAILER
3 C-1 NEIGHBORHOOD COMMERCIAL
C-2 LIMITED COMMERCIAL
C-H HIGHWAY COMMERCIAL
C-B CENTRAL BUSINESS
4 M-1 LIGHT INDUSTRIAL
M-2 HEAVY INDUSTRIAL
5 P PUBLIC

After these classes were formulated it was decided that to measure an effect of distance between two different zone classes, a system of weights would have to be devised. Further, as it was reasoned that closeness to a different zone type might be a factor in vacancies, the following weighting system was devised:

Table 3. Weights Assigned to Distance to an Unlike Zone

Distance from a vacant parcel located in one zone class, to the boundary of an unlike zone class in tenths of a mile.	Numerical value ascribed
0 - .99	3
1.- 1.99	2
2.00 or greater	1
Residential to commercial	4
Residential to industrial	5

The first three numerical values are direct measures of linear distance. However, in the instances where vacant parcels zoned residential bordered commercial or industrial zoned land, the lots were given a higher value. The reason behind this was that the physical closeness of the two diametrically opposed land uses was considered a decided influence on the existence of vacant parcels.

Access to Arterial Streets: (X_3)

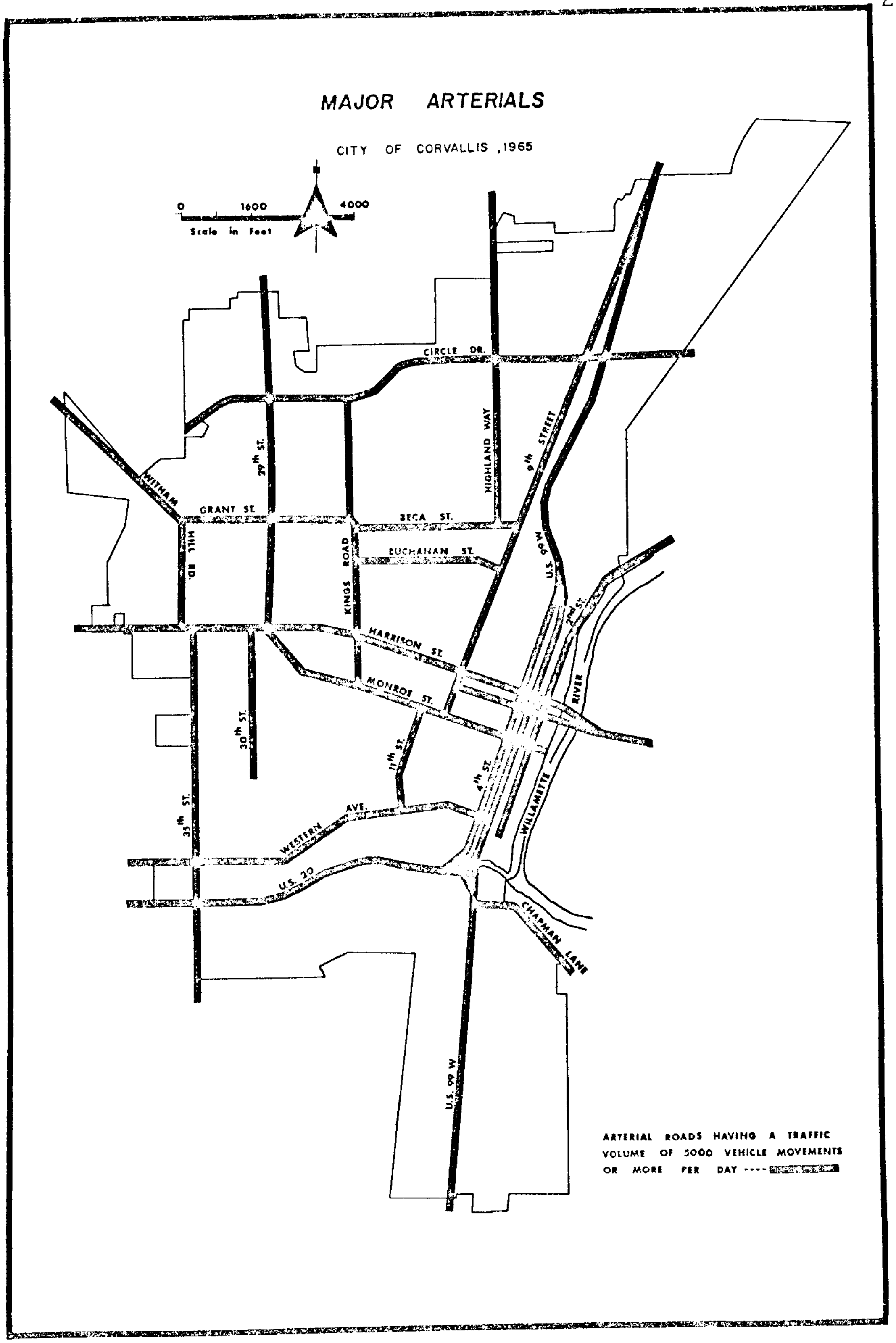
Access to an arterial street or road from a vacant parcel of land was a third variable selected. An arterial, as it is referred to in this thesis, is a road or street that has a volume of traffic of 5000 or more vehicles per day. Roads such as Harrison, Monroe, Third, Fourth, Circle Drive, and North Ninth are indicative of what the writer defines as an arterial. For a thorough look at all the streets in Corvallis termed arterials by the writer, see map three.

Access to arterial streets was selected as a variable because the writer felt that lack of such access might contribute to the existence of vacant parcels. It is the hypothesis of this writer that as distance from an arterial street increases, the lack of ready access will decrease. Therefore, the amount of vacant parcels would increase as the distance from an arterial street increases.

Numerically, access to arterials is set up the opposite way as distance to a contrasting municipal zone type. Thus, the following weighting system was devised.

Table 4. Weights Assigned to Distances from an Arterial

Distance to a major arterial in tenths of miles	Numerical value ascribed
0 - .399	1
.4 - .799	2
.8 - 1.199	3
no access	5


MAJOR ARTERIALS
CITY OF CORVALLIS, 1965
0
1600
4000
Scale in Feet
CIRCLE DR.
29th ST.
HIGHLAND WAY
9th STREET
WITHAM
GRANT ST.
BECA ST.
HILL RD.
KINGS ROAD
BUCHANAN ST.
U.S. 99 W
2nd ST.
HARRISON ST.
MONROE ST.
RIVER
30th ST.
11th ST.
4th ST.
WILLAMETTE
35th ST.
WESTERN AVE.
U.S. 20
CHAPMAN LANE
U.S. 99 W
ARTERIAL ROADS HAVING A TRAFFIC VOLUME OF 5000 VEHICLE MOVEMENTS OR MORE PER DAY ----

The first three entries in the above system are the direct product of distance and as distance increases so does the numerical value. In the case of a vacant parcel that was bounded on all sides by other properties or did not have physical access to the use of some sort of road, the numerical value of five is ascribed. This was done because the writer felt that distinction should be made between access and no access. All measurements were based on route distance measured on the map from the vacant parcel to the nearest arterial. (See Map 3, page 21)

Access to Utilities: (X_4)

Access to utilities refers to distance to four common utilities that can be obtained within the city limits of Corvallis, as in most urban centers. The utilities considered by this writer are natural gas, electricity, water, and sewage lines. It has been recognized by the writer that the distribution of these utilities is widespread but it was felt that lack of proximity to them might affect vacant parcels of land. Further, this writer reasoned, that as proximity to public utilities decreased, that is, as the vacant parcel is farther away from the utilities, the chances for that vacant parcel to remain in a prolonged state of vacancy increased. The reasoning behind this is that it would cost more money to have the distant vacant parcel connected to the utilities than a parcel that was adjacent to the utility lines. It is, therefore, the hypothesis of this writer that as distance from any or all utilities increases, the incidence of vacant urban land will increase. Following this line of reasoning, a system of weighting similar to access to arterials was devised.

Table 5. Weights Assigned to Distance from Utilities

Distance from the utility in tenths of miles	Numerical value
0 - .499	1
.5 - .999	2
1.000 or greater	3

The measurements for this section were obtained by utilizing three different base maps.

The first one, purchased from the city of Corvallis, showed the 1966 distribution of water and sewage lines in Corvallis (11).

Maps for natural gas and electricity were unobtainable in that a personal copy could not be had. However, the writer was allowed to use for measurement base maps that the natural gas and electric companies had in their district offices. Once again, measurement was by route distance measured on the map (30, 33).

Physical Limitations: (X_5)

Physical limitations constituted the fifth and last variable considered by the writer. The physical limitations selected by the writer include: 1) slope, 2) standing water or poor drainage, 3) chronic stream overflow, 4) outcrops of rock, 5) unusual parcel shape, and 6) unstable subsurface materials. It is the hypothesis of this writer that these physical limitations should inhibit building on various vacant parcels. Thus, they should remain in a prolonged state of vacancy until whatever physical limitation or limitations they have is or are overcome.

Slope, as used in the context of this writer, is a term referring to buildability (29, p. 4). That is to say, the greater the slope the greater the chance for vacancy because unduly steep slopes do not lend themselves easily to building. Slope, as the writer used the term for measure, referred to any slope of land approximately greater than thirty degrees. The degree of slope was estimated by the writer. Further, in the case of a vacant parcel that consisted of both slope and flat land; the writer considered that to be classed as sloping, the vacant parcel should have over fifty percent of its area in extreme slope.

Standing water or poor drainage is the result of climate and soil. It is not the intent of the writer to discuss these two topics in depth but merely to mention them as causal factors. Both types of phenomena, standing water and poor drainage, are commonly related to Dayton soil found widely in the Corvallis area.

Chronic stream overflow was used to measure the effect that regular overflow of streams might have on vacant parcels of land. There were three main streams that do or could experience such occasional flooding; 1) the Willamette River, 2) Marys River, and 3) Dixon Creek.

Rock outcrops were included in the physical limitations to see if the presence of rock on vacant parcels might be a factor influencing vacancy. However, as it turned out, very little bare rock was observed within the city limits. This was a factor in name only: it affected no measurement.

Parcel shape was used because the writer felt some form of mathematical expression should be made of odd shaped vacant lots such as three sided or five sided lots, to distinguish them from regular four sided lots. Therefore, any lot that was vacant and did not have four sides, forming a common square or rectangle, was given a value of two to distinguish it from other vacant lots.

Unstable subsurface materials was used because the writer found an area in Corvallis on North 29th Street where this factor was a hindrance to home building. Unstable subsurface materials occur when previously deposited materials, existing below the surface of the land, become charged with water during periods of extended precipitation, thereby, altering once firm subsoil to the consistency of mud. The effect is that structures on the surface have to be built on pilings in order to insure proper construction.

In order to measure the effect of the physical limitations on a vacant parcel of land, each of the subvariables under the broad heading of the major variable, physical limitations, received a numerical value of two. It is the sum of these parts together which determines the amount or degree to which the physical limitations affect the vacant parcel of land. Where no physical limitations were perceived, vacant parcels were given a numerical value of one. To illustrate this point assume that a selected vacant parcel has physical limiting factors of slope, unstable subsurface material, and is subject to chronic stream overflow, therefore, the numerical value assigned to the effects of the physical limitations on that vacant parcel would be six. The following table is added to illustrate the manner in which this variable was expressed for each given vacant parcel.

Table 6. Weights Assigned to Physical Limitations

Feature	Value
1. Slope	2
2. Standing water poor drainage	2
3. Chronic stream overflow	2
4. Rock outcrops	2
5. Parcel shape	2
6. Unstable subsurface material	2
7. No limiting factors	1

FORMULA AND PROCEDURES

After the variables were selected and measured, the question of how best to assess them arose. Initially, it was decided that each of the variables would be included in a form of linear algebraic equation thusly:

$$VL = X_1 + X_2 + X_3 + X_4 + X_5$$

where V L equals a single vacant parcel and the X values represent the five variables previously mentioned. However, this line of thought breaks down when one recalls that the aim of this thesis is to try to explain the effects of the variables on the amount and distribution of vacant parcels of land. The point to be made here is that the above equation consists only of independent variables, there is no dependent variable, so measurement as to the amount and distribution of vacant parcels of land cannot be affected.

To alleviate the problem, a grid system was devised to cover the city of Corvallis. The grid consisted of 147 square cells, each 30 acres in size. The point of origin of the grid was the highest value corner of the central business district from which all previous distance had been calculated. With the development of the grid system it was possible to measure the effects of the selected variables, because the grid reformulated the problem in such a way that it allowed for the selection of two dependent variables and five independent variables. The reformulated variables would be as follows:

Dependent variables	Y_1	The number of vacant parcels in each cell
	Y_2	The sum of the acreage of vacant parcels within each cell.
Independent variables	X_1	The average distance to the focal point of the central business district from the vacant parcels within each cell.
	X_2	The average value of the weights assigned according to the distance from the nearest unlike municipal zone.
	X_3	The average value of the weights assigned according to the distance from a major arterial.
	X_4	The average value of the weights assigned according to the distance from the nearest utility.
	X_5	The average value of the weights assigned according to the physical limitations within each cell.

With the reformulated variables, the vacant parcels in each cell of the grid were assessed. To do this, it was necessary to add the weighted or unweighted values of the variables of the vacant parcels in a given cell and obtain a sum for each variable for that cell. The following assumed cell example should help to illustrate this point.

Table 7. Assumed Cell

Vacant Parcel	Y_1	Y_2	X_1	X_2	X_3	X_4	X_5
1	1	3.	2.4	2	2	1	4
2	1	3.2	2.6	3	1	2	2
3	1	4.	2.2	1	2	1	6
4	1	2.2	2.4	1	1	2	6
5	1	2.4	2.6	3	2	1	4
6	1	1.1	2.4	2	1	2	2
7	1	1.1	2.2	2	2	1	4
Σ .	7	17.0	17.0	14	10	10	28
$\bar{X}$.	. . .	. .	2.4	2	1.4	1.4	4

In the cases of distance to the central business district (X_1), distance to unlike municipal zones (X_2), access to arterials (X_3), access to utilities (X_4), and physical limitations (X_5), the sum values were obtained and then averaged. The writer realizes that by grouping all the vacant land and variables in one cell of the grid into sums that the effect of variance may be lost, in either one or all of the variables. Yet, this was necessary because a dependent variable had to be obtained by grouping data in order to make measurements relating to the amount and distribution of the vacant parcels.

With regard to the dependent variables obtained from the grid, the number of vacant parcels per cell (Y_1) and the total acreage vacant per cell (Y_2), it was felt that these should remain as sums and not be averaged. The writer's reasoning behind this thought was that vacant land should be presented as a total figure both in number of vacant parcels and vacant acreage per cell in order to relate the variables most effectively.

Having arrived at this point, the writer wishes to point out that a quantitative model has been developed from the grid system. The model is such that it allows for the measurement of the effects of the independent variables, the X values, on the dependent variables, the Y values.

There are two formulas used to explain what spatially distributed variable factors are associated with the existence of vacant urban land. One uses the model presented; the other correlates the values derived from the model into correlation coefficients. The formula using the model directly is the standard one for establishing linear correlation (16, p. 459). The equation is stated:

$$Y = a + bX_1$$

where:

Y = numerical value of the dependent variable Y.

a = derived quantity that will indicate where a regression line intersects the Y axis of a graph.

b = derived quantity that will indicate the slope of a regression line.

X_1 = numerical value of the independent variable X_1.

This is two variable linear correlation and is only the first step in analyzing the variables. Further correlation equations bring into play the effects of two or more independent variables on the dependent variables. As such, the formula becomes progressively longer as each step is reached. To illustrate the point assume that a correlation is to be made between two independent variables and one dependent variable. The formula would be $Y = a + bX_1 + cX_2$. The only significant difference between this formula and the one previously presented is the addition of the independent variable cX_2, which is, for this writer's purpose, the numerical value assigned to the distance from a vacant parcel of land to the nearest unlike municipal zone.

Therefore, with the addition of an independent variable for each step involved, the equation finally evolves into $Y = a + bX_1 + cX_2 + dX_3 + eX_4 + fX_5$. Once this stage has been attained it is possible to measure the effects of each of the independent variables (X) on each of the dependent variables (Y).

It was by the use of this estimating equation, $Y = a + bX_1 + cX_2 + dX_3 + eX_4 + fX_5$, that the map of residuals from regression was developed. (See map four) In order to derive the map of residuals several steps had to be developed. First, the computer established the equation by using one dependent variable against five independent variables. The results were found for all 113 cells of the grid. This was accomplished by the use of the estimating equation, where Y equals either of the dependent variables and X each of the independent variables already discussed. The following example of an actual cell showing both the formula and the actual dependent and independent variables should illustrate the point.

$$Y_1 = a + b\ 2.5 \text{ (with } X_1 = 2.5)$$
$$Y_1 = a + b\ 1.0 \text{ (with } X_2 = 1.0)$$
$$Y_1 = a + b\ 2.0 \text{ (with } X_3 = 2.0)$$
$$Y_1 = a + b\ 1.0 \text{ (with } X_4 = 1.0)$$
$$Y_1 = a + b\ 2.0 \text{ (with } X_5 = 2.0)$$

From the results of this analysis the computer derived three columns of figures each 113 entries long. These columns of figures represented the results of testing of the model. The following example should help to illustrate this point.

Cell One

Actual value	Predicted value	Deviation	Deviation, as the standard error of estimate
2.000000	8.437958	-6.437958	-.799

In the above figure the actual value is the dependent variable (Y), the number of vacant parcels per cell. The predicted value is the result of the equation $Y_c = a + bX_1 + cX_2 + dX_3 + eX_4 + fX_5$ using the five independent variables in place of the X values. The deviation is simply the predicted value minus the actual value.

In order to simplify the deviations and bring them into a more workable figure, each deviation was divided by the standard error of the estimate which was +8.05. Essentially all that is done here can be explained by the common formula $Y - Y_c/S_{yc}$ (38, p. 19). where:

Y = actual values

Y_c = predicted values

S_{yc} = standard error of estimate

What this formula does, besides simplify the data, is to express more effectively the spatial distribution of the vacant parcels in the cells. In so doing, the formula expresses the relative role of the independent variables in estimation. Once this formula was used for all the cells, the writer was left with values ranging from 1.187 to -1.111, much easier figures to handle and map than those of the deviations alone which ranged from 9.551581 to -9.972442.

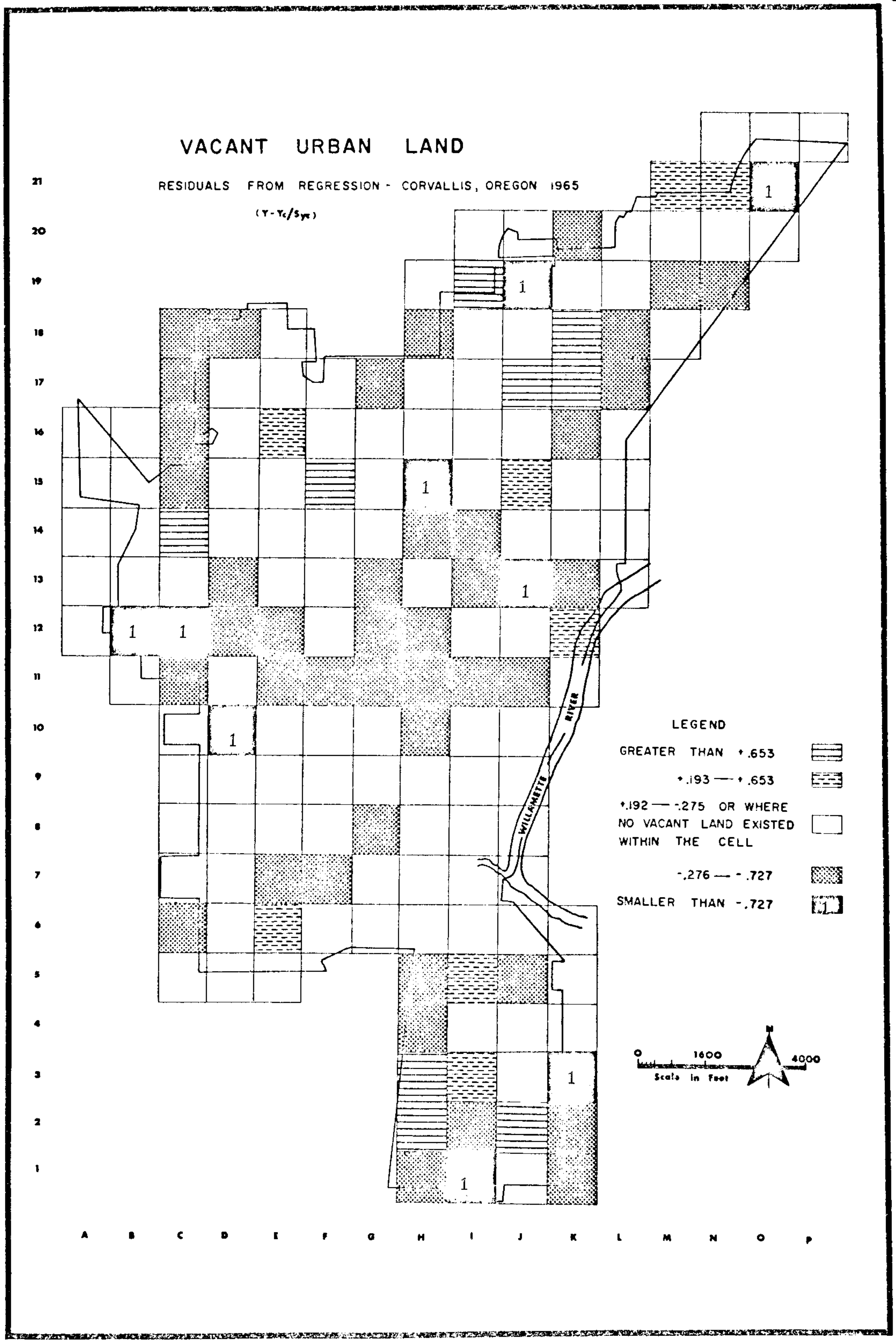
RESIDUALS FROM REGRESSION

At the outset of this section of the thesis the writer wishes to indicate that the study of the residuals from regression analysis is done in two parts. The first section deals with the causes of over-prediction and underprediction as they relate to the grid system covering Corvallis. The second section deals briefly with a few of the more prominent groups of residuals be they over- or under-predicted. Also, in this section constant reference is made to the map of residuals from regression found on page 36.

The map depicting the residuals indicates that out of the original 113 cells included in the analysis, 68 were either over or underpre-dicted. Further study of the map shows that 17 cells were over-predicted and 51 cells were underpredicted. Therefore, it appears that the model underpredicts more than it overpredicts.

With regard to the 51 underpredicted cells, it should be noted that out of a total of 51 cells, 42 fell in the class -.276 to -.727 which the writer defines as marginal underprediction. However, the remaining nine cells fell in the class below -.727 which the writer defines as serious underprediction.

In regard to the 17 cells that were overpredicted, the map indicates that out of a total of 17, eight cells were marginally over-predicted. The remaining nine cells were seriously overpredicted.


VACANT URBAN LAND
RESIDUALS FROM REGRESSION - CORVALLIS, OREGON 1965
(Y - Yc/Syc)
LEGEND
GREATER THAN +.653
+.193 — +.653
+.192 — -.275 OR WHERE NO VACANT LAND EXISTED WITHIN THE CELL
-.276 — -.727
SMALLER THAN -.727
WILLAMETTE RIVER
0 1600 4000
Scale in Feet
N

With regard to the 51 underpredicted cells a few broad statements need to be made in order to clarify why they were underpredicted. A study of the raw data from which the residuals were derived indicates the following results.

Table 8. Data of Underpredicted Cells

Variables	Results of raw data of all underpredicted cells
Y_1	A range of from one to ten vacant parcels per cell. Further, 31, of the total of 51 cells, had fewer than five vacant parcels per cell.
Y_2	Vacant acreage ranged from 7.03 to .11 acres per cell for all the cells that were underpredicted. Further 34 of the 51 cells had less than two acres per cell.
X_1	The distance varied from .5 to 2.4 miles but it seems that a pattern of underprediction is developed in the central city and along the city borders. The data indicate that of the total 51 underpredicted cells, 16 are located in the central city area. Further, of the 35 remaining underpredicted cells, 22 are located along the city borders. The remaining 13 cells are randomly distributed.
X_2	Only in three out of the total of 51 underpredicted cells was this factor more than the numerical value one.
X_3	Usually this value was one. Only in five cells of the original 51 underpredicted cells was the numerical value greater than one.
X_4	This value had a numerical value of one for all 51 underpredicted cells.
X_5	Only in 16 cells was this value more than two.

It can be ascertained from the preceding table that the three main causes of underprediction in Corvallis may be attributed to 1) number of vacant parcels per cell being low; 2) the total acreage vacant per cell being low; and 3) the effect of distance from the focal point of the central business district seems to become critical as the city boundaries are approached. The rest of the variables X_2, X_3, X_4, and X_5 all show relatively the same pattern and, as such, it is doubtful that they would affect underprediction.

A close study of the map of residuals shows three broad areas where marginal underprediction in the range of -.276 to -.726 occurred. One area is located in the central part of the city with a linear attitude of east to west. (Note on the map key, cells 1 -C, E, F, G, H, I, and J; also, cells 12 - D, E, G, and H.) It was found from an analysis of the data that this area was marginally underpredicted because of two of the three aforementioned factors. More specifically, the two factors are 1) that out of the total 17 cells comprising the core area group all cells averaged three or fewer vacant parcels; and 2) with the exception of one 7.03 acre vacant parcel, all the cells had less than one acre in vacant parcels. Distance from the focal point of the central business district did not seem to affect this area. Rather, it seems that the net effect of the dependent variables is not enough to predict correctly when so few vacant parcels exist. Therefore, the cells are underpredicted.

The other area of grouped marginally underpredicted cells occurs along a north-south trending line in the northwest section of the city. (Note C-15, 16, 17, 18.) What was true of the marginally underpredicted area in the central part of the city also holds true for this area because once again there are few vacant parcels per cell and correspondingly small vacant acreages per cell. The rest of the data for both areas seems fairly constant, however. With specific regard to this area, it seems that distance from the focal point of the central business district becomes a factor. Since 29 of the 51 under-predicted cells occur on or not more than one cell removed from the cities outer boundaries, the writer is led to believe that as distance increases it does become a factor.

With regard to the overpredicted cells the following table has been provided to clarify the writer's further comments

Table 9. Data of Marginal Overprediction

Variable	Results of raw data of overprediction +.193 - +.653
Y_1	Six of the seven cells contained fewer than ten parcels of vacant land.
Y_2	Vacant acreage averaged ten acres per cell.
X_1	Distance varied from 0.6 to 2.3 miles from the focal point of the central business district.
X_2	Zone values varied slightly from a numerical value of 1.0 to 2.5.
X_3	Arterial values ranged from 1.0 to 3.0.
X_4	All values were 1.0
X_5	Physical limitation values ranged from 1.0 to 2.0.

Table 10. Data of Serious Overprediction

Variable	Results of raw data of overprediction greater than +.653
Y_1	Number of vacant parcels for the nine cells ranged from 12 to 16.
Y_2	Only two cells had more than ten acres vacant. The average was 6.4 acres vacant per cell.
X_1	Of the nine parcels, eight were less than two miles from the focal point of the central business district.
X_2	Zone values ranged from 1.0 to 2.13.
X_3	Arterial values indicated that of the nine cells, seven had values of one. The remaining two were slightly higher at 1.5.
X_4	All values were one.
X_5	Physical limitations all were presented as 2.0, a basic figure for this variable.

With regard to the marginally overpredicted cells in the range of .193 to .653, a close study indicates that the number of vacant parcels per cell and the size of the parcels within the cells are the mitigating factors. In all the cases the number of vacant parcels per cell is fairly high (about 13 per cell) but the vacant acreage per vacant parcel is small. That is, within the cells the vacant parcels average about .22 acres in size. The rest of the data, comprised of the independent variables, shows little variance or magnitude and it is doubtful that it would affect the distribution of the cells.

The seriously overpredicted cells in the range greater than

.653 show a rather widespread distribution. Only in one instance do two seriously overpredicted cells adjoin. (Note 12-B, C.) Where these two cells adjoin, the data indicate that the number of vacant parcels is small, only four per cell, and the acreage vacant is minimal, only 2.13 acres total for both cells. Also, the data indicate for these two cells, the numerical values of the physical limitations is greater than two. The rest of the variables are roughly constant and do not seem to have varied much from the rest of the data.

For the seven scattered cells, the analysis of the data reveals essentially the same pattern as for the two adjoining vacant parcels. Therefore, it would seem, to this writer, that the over overriding causes of serious overprediction, are threefold. That is, 1) small number of vacant parcels, 2) total vacant acreage per cell is small, and 3) the values assigned to the physical limitations are higher in these instances than in all the others, therefore the physical limitations seem to be a factor.

ANALYSIS OF THE DATA

The results of this thesis were arrived at through the use of regression analysis, where the two dependent variables were correlated separately with the five independent variables. Further, the results were derived by the use of computer techniques. The formula used was the Pearson Product Moment Coefficient Correlation (16, p. 469).

The basic task of the coefficient correlation is to indicate by the use of mathematical expression the degree of correlation between the selected dependent and independent variables. The degree of correlation will be expressed as either a positive or negative value ranging between 1.00 and -1.00.

The data derived by the computer are shown in the following matrix:

Table 11. Simple Correlation Coefficient Matrix

	X_1	X_2	X_3	X_4	X_5	Y_1	Y_2
X_1	---	-.936	.929	.156	.311	.239	.202
X_2	-.936	---	.682	-.173	-.747	-.664	.117
X_3	.929	.682	---	.545	.177	-.677	-.117
X_4	.156	-.173	.545	---	.236	.149	-.688
X_5	.311	-.747	.177	.236	---	-.599	.143
Y_1	.239	-.664	-.677	.149	.599	---	.543
Y_2	.202	.117	-.117	-.688	.143	.543	---

From the figures presented here an analysis of the data can proceed. The analysis will be affected by studying the correlation value of each independent variable to both of the dependent variables.

X_1 Correlation

Focusing on the first independent variable, the average distance of the vacant parcels in each cell to the highest value corner of the central business district, it should be noted that in both instances the r value is small. In the case of Y_1 it is .239 and with Y_2 it is .202; both are indicative of a low positive correlation. From these data the writer concludes that there is little correlation between the number of vacant parcels or the acreage of the total vacant parcels as one travels outward from the central business district.

This is not what the writer expected when the variables were formulated. At that time the writer hypothesized that as distance from the central business district increased, the number of vacant parcels and correspondingly the total vacant acreage would also increase. The only explanation this writer can offer, to explain why the correlation is so low, is that in Corvallis the growth pattern of the city is such that greater numbers of vacant parcels and, correspondingly, greater vacant acreages exist closer to the central business district than was previously thought. This would explain the low positive correlations. Also, it should be recognized at this point, that Corvallis is an underbounded city (19, p. 186). By this it is meant that the city bounds include less area than effectively devoted to urban settlement. Possibly, if the study area were expanded to include the entire built-up area the degree of correlation might be greater.

X_2 Correlation

The second independent variable, the average distance to the nearest unlike municipal zone, presents r values of -.664 to Y_1, and .117 for Y_2. This means that for Y_1, the number of vacant parcels per cell, a negative correlation exists but for Y_2, the total acreage vacant per cell, a low positive correlation exists. It will be recalled that the writer hypothesized a negative correlation in both instances. As the data indicate, this is true for only one of the dependent variables. The r value of -.664 for the total number of parcels is consistent with what the writer hypothesized originally, but the figure of .117 for the total acreage correlation is quite low and just the opposite of the original hypothesis. With regard to the r value of -.664, although it is not as high as the writer originally hypothesized, it does indicate that as distance to an unlike zone decreases, the number of vacant parcels increase. Perhaps if the measuring system was altered to show actual average distance instead of weighted distance based on grouped values the correlation would be better.

The low positive r value of .117, which refers to the correlation between the total acreage vacant and the distance from the nearest unlike municipal zone, indicates that although there may be an increased number of vacant parcels, there is not a corresponding increase in vacant acreage. Therefore, the parcels must be smaller in the areas where zone boundaries exist.

X_3 Correlation

The third independent variable, average distance to a major arterial, shows two negative correlations, the opposite of what was originally hypothesized. With regard to the dependent variables, Y_1 and Y_2, the correlation figures are -.667 and -.117 respectively. From these figures the writer is able to estimate that distance to a major arterial apparently is not a major factor in explaining the amount and distribution of vacant parcels of land in Corvallis. Perhaps a better way to show a more positive relationship would be by measuring both time and distance to the arterial from the vacant parcels, such as Chapin and Weiss suggest. This might enable one to arrive at a different answer; one that might indicate a higher relationship.

X_4 Correlation

The fourth independent variable, access to services, presents r values of .149 and -.688 for the dependent variables Y_1 and Y_2. In effect, these correlations refute the original hypothesis that as distance from a service increases, the amount of vacant land will increase. As stated before, perhaps this variable might be more pertinent if the study area was expanded. Perhaps, because of the widespread availability of the services, the variable should be dropped from the analysis. However, the exploration of this variable at least indicates that access to services should not be a factor explored in any further study attempting to determine the underlying causes of vacant urban land in Corvallis. If, however, it is, a different form of measurement should be devised to express its relationship to vacant land more effectively than was done in this thesis.

X_5 Correlation

The fifth independent variable, the sum of the physical limitations reveals r values of -.599 and .143 for the dependent variables Y_1 and Y_2. As indicated in the original hypothesis the greater the value ascribed to the vacant parcel, the higher the chance of it remaining in a vacant state. However, the data presented do not support the original hypothesis. It is indicated by these figures that perhaps physical limitations are not as much a hindrance to building in the Corvallis area as the writer originally hypothesized. At any rate, if further study is attempted along this line, it is suggested that some alternate form of expression for the physical limitations be applied to the vacant parcels rather than that used by this writer. By the use of a different expression one might be able to ascertain if physical limitations should even be considered as a factor that might possibly explain the amount and distribution of vacant urban land.

CONCLUSIONS

From the results of an analysis of the data supplied by the simple correlation coefficient matrix, the writer wishes to indicate that in most instances, the original hypotheses developed by the writer were refuted. Only in the case of distance to an unlike municipal zone was the writer's hypothesis supported and then only slightly.

In retrospect, the writer still feels that the hypotheses originally suggested should be maintained, as it is the writer's opinion that these are still valid. However, in order to express the relationships of the variables presented here in any further study, another method should be used. For instance, other forms of measurement should be utilized, because as indicated in this thesis, the variables used poorly portray the spatial relationships presented. For example, in place of the class form of distance measurements the writer used, perhaps actual distance would be better.

By way of explanation of the aforementioned point, it should be recalled, that the writer used only classed distance measures to portray distance for most of the independent variables (physical limitations was not classed as a distance variable); but these were further compounded by being grouped again under the grid system. The writer has indicated before that the effect of grouping these measures levels out any effect of variance the vacant parcel might possess. However, this was necessary if the grid system was to be utilized and it was sorely needed at that point in writing the thesis, because it reformulated an unworkable problem into a workable form by allowing for development of the two dependent and five independent variables. Therefore, in view of what has been stated, perhaps actual distance measures would be better than the classed measures.

Also, it may be that a further study along these same lines could delete one or more of the variables presented in this thesis and use other variables quite dissimilar, such as, assessed value of the vacant parcels or accessibility to work areas and service centers. These could be used in hopes of portraying a clearer relationship than the variables used.

Further, as the data from regression analysis indicate, perhaps the study area should be expanded. It will be recalled at this point that numerous marginally underpredicted cells occur along the boundary area. Perhaps, if the study area were expanded, these cells would fall in another class and as such would portray the spatial relationships of vacant urban land more effectively.

It would seem to the writer that if all the features the writer has mentioned were taken into account, perhaps a more adequate explanation of the amount and distribution of vacant urban land in Corvallis, Oregon could be presented.

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