

MEASUREMENT OF THE AFFECT OF AIR POLLUTION FROM THE  
NORTH ALBANY INDUSTRIAL COMPLEX ON NEARBY  
AGRICULTURAL AND RESIDENTIAL LAND VALUES

by

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MEASUREMENT OF THE AFFECT OF AIR POLLUTION FROM THE  
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ABSTRACT: Since the mid-1950's, when Western Kraft Corporation began operation of a pulp and paper processing plant north of Albany, Oregon, inhabitants of the Albany area have faced an air pollution nuisance.

This study is an attempt to add empirical substance to the complaint that air pollution reduces land values. The nature of the study necessitates the development of a new methodology which includes: (1) establishing a study area, (2) pinpointing key variables, (3) determining parcel values, and (4) employment of a statistical comparison.

In developing the study it is apparent that the reliability of some of the variables is disputable; however, the evidence as presented suggests that air pollution has no effect on land values.

INTRODUCTION

In recent decades Americans have become increasingly aware of their decreasing environmental quality. An example of this phenomena is industrial air pollution. It is clear that air pollution is not an amenity to be sought but rather a nuisance to be avoided in residence locating. Hypothetically then, if people wish to avoid air pollution, the space that is affected by it should experience a decreased demand and therefore a decreased value. This statement would, of course, remain valid only when the use of the polluted land remains the same.

## THE PROBLEM

The problem to be examined in this study is: Does air pollution decrease or depress agricultural and residential land values? To seek an answer a field study of the urban-rural fringe of Albany, Oregon, was conducted.

Albany is situated in the central Willamette Valley in northwestern Oregon. Presently the city has about 14,000 residents and is characterized by rapid suburban expansion. The topography of the area is relatively smooth. Western Kraft (pulp and paper mill), Duraflake (pressboard plant), and WaChang (metalurgical plant) on the northern fringe are the city's major industries. All discharge wastes into the atmosphere.

## REVIEW OF THE LITERATURE

Considerable literature exists that is devoted to the theory of residential land values. Establishments such as factories, railroads, and docks are generally recognized as nuisances to residential land use. Air pollution, although not so frequently mentioned in this category of literature, is also considered a nuisance factor. Hugh O. Nourse, a regional economist and author of, "The Effect of Air Pollution on House Values," (Land Economics, May, 1967) states that, ". . . urban land economists and real estate appraisers have from

time to time made general comments that nuisances, including air pollution, made a neighborhood a less desirable place to live."<sup>1</sup>

But, as Mr. Nourse observes, the evidence behind the general comments is, ". . . quite skimpy."<sup>2</sup>

Nourse's interest in the air pollution aspect of land economics led him to the investigation of such a problem in St. Louis, Missouri. His effort was the first attempt to prove that air pollution affects property and house values. Nourse's method was to delimit several neighborhoods according to census tracts. The independent variables in his regression equation were as follows:

1. Index of air pollution level
2. Median number of rooms
3. Percent of all housing units built from 1950 to March 1960
4. Houses per square mile
5. Distance in time from the Central Business District
6. Accessibility to major through streets
7. School quality
8. Percent of workers in blue collar occupations
9. Persons per unit
10. Percent of units occupied by non-whites
11. A dummy variable indicating whether the tract was in Illinois or Missouri to account for differences in property taxes
12. Median family income in 1959<sup>3</sup>

The results were positive; that is, the improvements and property of the polluted neighborhoods decreased in value. But Nourse concludes, ". . . this estimate must be interpreted with caution." Similar reductions in value existed in some neighborhoods for no apparent reason.<sup>4</sup> In short, despite extensive variable consideration Nourse was not able to isolate air pollution as the only value-depressing factor.

Another study that has relevance for this paper was conducted by Vernon Chock and reported in a thesis for a Master of Science degree at Oregon State University. Chock conducted a questionnaire survey of a suburban community of approximately 300 people in the two-mile area adjacent to the North Albany industrial complex. Three of the results are worth note: First, nearly ninety percent of the citizens participating in the survey believed there is a definite air pollution problem. Second, most of the 300 people surveyed in the North Albany area believed their land was worth less than if air pollution were absent. Third, ten percent of the people surveyed stated they had noticed some damage to crops and plants in general.

These results add considerable weight to the development of the theory and problem on which this study is based.

## THE METHOD

### Deriving the Study Units

The reason for choosing residential land for the purpose of the present study has been made clear. Additionally, agricultural land is included because it has received relatively little attention in previous research and the Albany area offers an excellent example. This inclusion was stimulated especially by Chock's study, which alluded to influences on crops due to air pollution.

### Selecting the Study Area

The first problem in selecting a study area was made apparent by Nourse, who had trouble obtaining an error-free study due to a lack of variable control. His study area, St. Louis, introduced so many complex factors that it became virtually impossible to relate certain value phenomena to any single factor. Therefore, an attempt was made in this study to choose an area that minimized value-affecting factors.

The second problem was to establish an area of comparison. The Oregon State Sanitary Authority has only one station that checks total air pollution particulate in the North Albany area.<sup>6</sup> Without data that indicated the exact level of pollution a given parcel of land would have (Nourse had particulate data by neighborhoods<sup>7</sup>), a



correlation of land values and the level (amount) of pollution was impossible. To avert this problem it was necessary to compare the area most likely to be polluted (with such scant pollution data an area of pollution cannot be definitely established<sup>8</sup>) with an area nearly the same without air pollution.

With these problems and criteria in mind the area chosen for the study was a circular band one mile in width, the center of the band being determined by the major source of pollution, Western Kraft Pulp and Paper Mill,<sup>9</sup> with the focal point of the entire band being located at Albany's Core Area (Third and Ellsworth). As Figure 1 indicates, the band makes a semicircle rather than a complete circle. There are several reasons for the limited extent:

1. A complete circle would enter Benton County and therefore encounter a different taxing base, the value determiner for this study.
2. Any further extension on the southern end of the band, which is terminated by Hwy. 99E (with the exception of Subdivision 5, Figure 9) would encounter a large area of unbuildable land, the floodplain of the Calapooya.
3. Similarly, an extension of the northern end of the band, limited by Interstate 5, would cross a large area of industrially-zoned land which is bounded on the west by the Willamette floodplain. Figure 2 indicates a triangular portion of the study area west of Interstate 5. This land was considered because it is north of the

# ALBANY & SURROUNDING STUDY AREA

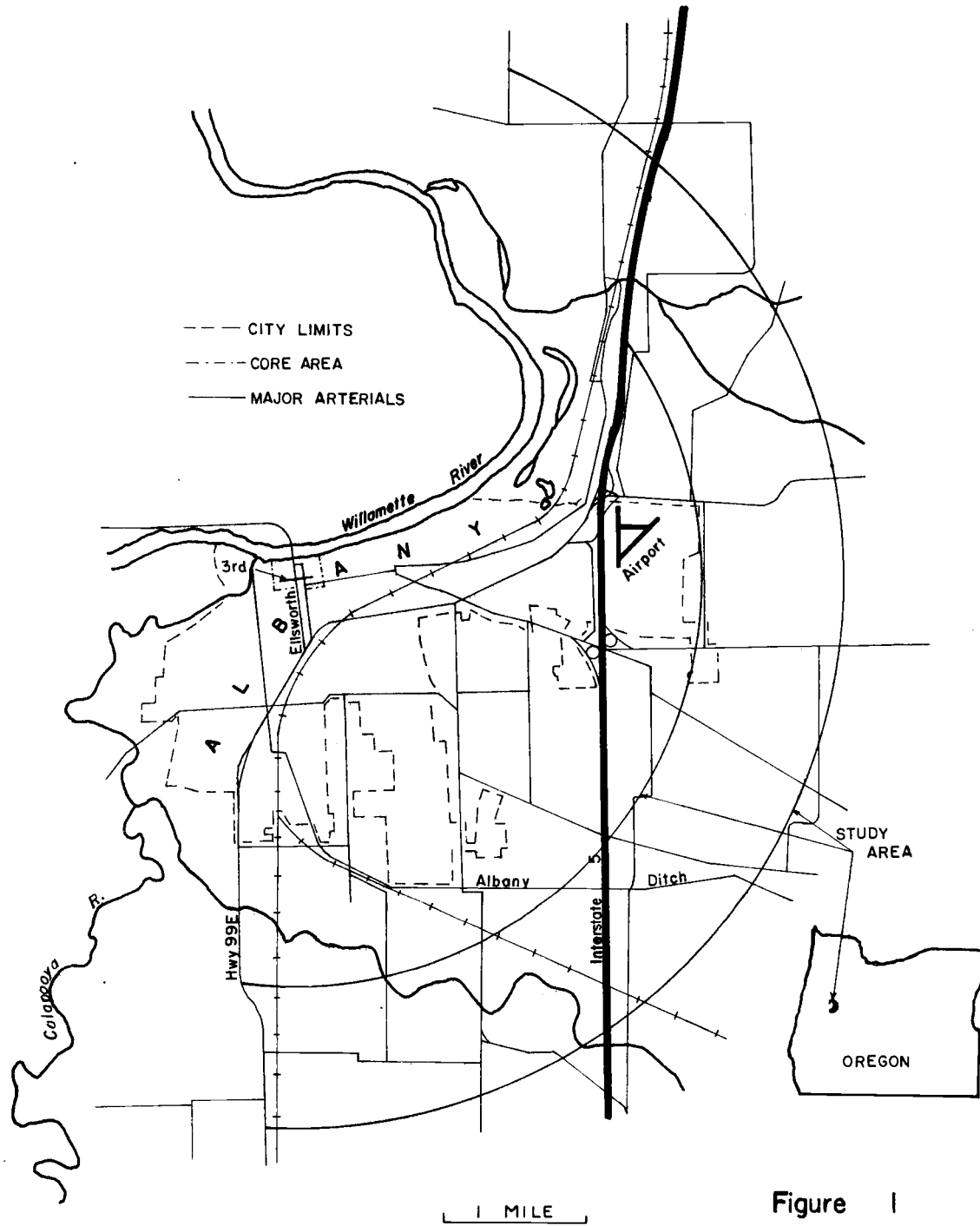


Figure 1

# STUDY AREA & SITUATION

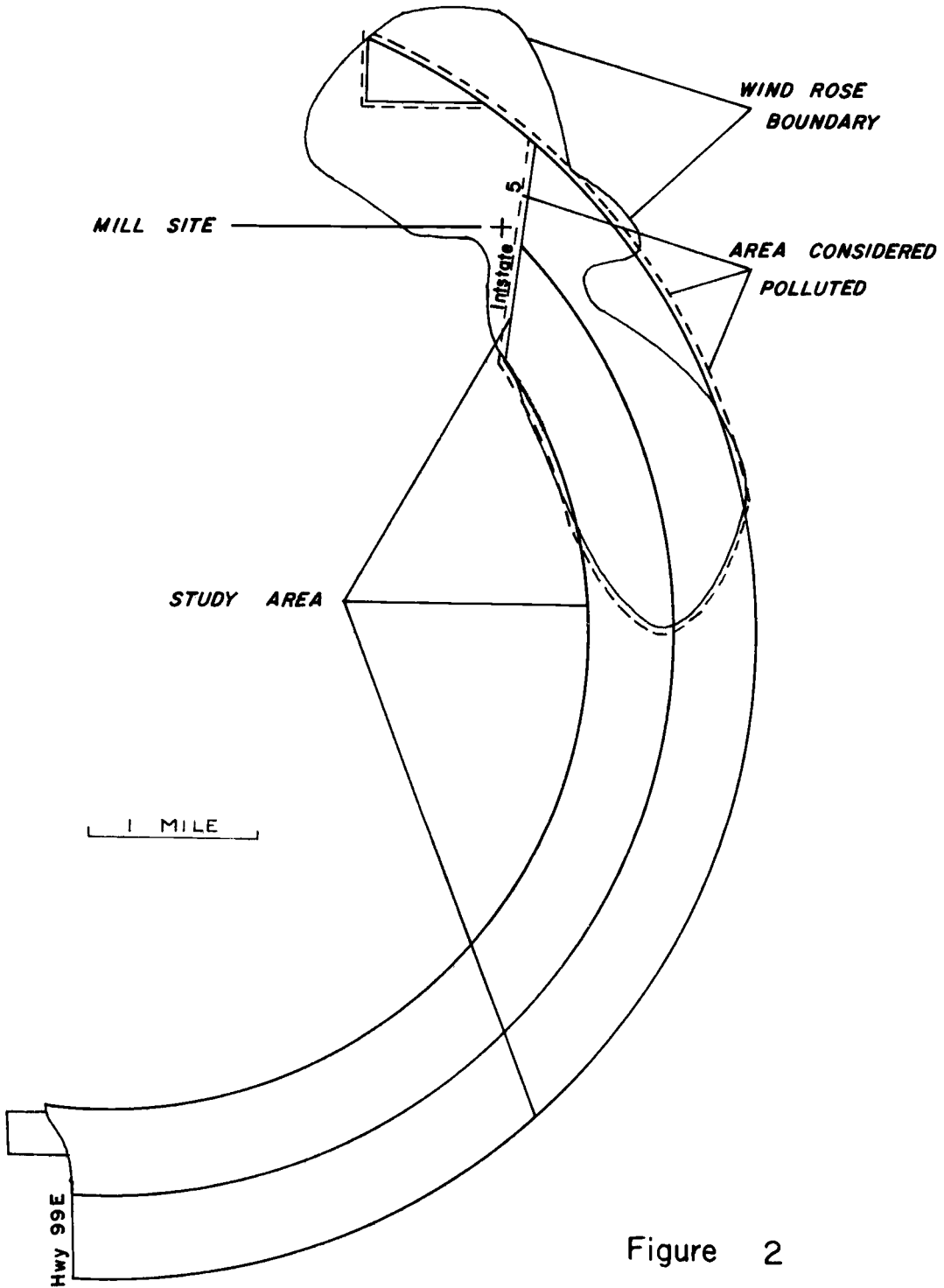


Figure 2

industrial zone and because it is dominantly residential, which offers an additional area of comparison.

The ends of the semicircle were terminated as such due to an effort to limit the variables. If the semicircle were extended on either end, large areas of low suitability and possibly a different tax base would have to be considered.

The semicircular shape was chosen because it "fits" the urban-rural fringe of Albany and it also limits the amount of bias due to accessibility. Arbitrarily it was decided that any parcel that the band crossed would be included in the study.

The end result is a semicircular band that encompasses a large study area on the fringes of the city limits of Albany.

#### Deriving the Polluted Area

The problems of establishing the pattern and boundary of a pollution area are apparent. Particulate data is extremely sparse. Therefore approximation was necessary on the basis of the following. The areal pattern that the pollutive would normally assume was derived from the annual wind rose of the mill site. The determination of the distance to which the pollutive is effective was derived as follows: Since Chock's study indicated that about ninety percent of the population living within a two-mile radius of the Western Kraft Pulp and Paper Mill believed there is a definite air pollution problem, it

was decided that in the strongest wind direction a distance of about two and one-quarter miles would be affected. Having established the distance of the strongest wind direction a standard ratio was derived and applied to the remaining fifteen wind rose directions. From this an affected area was determined, as can be seen on Figure 2. The extent of the established wind rose boundary so nearly covers the whole northern end of the band that all parcels north of the southernmost portion of the wind rose boundary were considered as affected area (Area Considered Polluted). The remaining portion of the band was considered as non-affected area.

#### Deriving the Variables

In establishing the study area an effort was made to eliminate all unnecessary or confusing variables without endangering the study area size. Two of the most difficult value-affecting variables to define, accessibility to the city center and the pollution level, have been negated. Because of Albany's arterial system and the semi-circular pattern of the study area no significant difference in value due to accessibility should exist. This holds true even when Interstate 5 is considered. Neither the affected nor the non-affected areas have any access to the freeway. Also, the freeway's presence in both the affected and non-affected areas should cancel any land value due to its presence. The pollution level (amount of particulate) a given

parcel has need not be considered due to the establishment of a polluted area.

Other variables which Nourse considered that need not be considered in this study are the age and type of the house, the type of occupant, persons per unit, and density of the housing for two reasons: (1) This study is related to land value, not improvement value; and (2) the assessor places the land value at its highest and best use.<sup>10</sup> Still another variable of no concern is the presence of a minority group.

Other factors that will not be considered that could seriously affect land value are particular types of nuisance factors such as busy highways and/or industrial menaces. An examination of the area indicates that there are few such factors in the area, and moreover if such conditions do exist, then both the polluted area and the non-polluted area are affected.

The only significant value-affecting variable other than air pollution to be considered is the land itself. In both agricultural and residential land uses the suitability of the land for each use would have a serious effect on the value. For the purpose of tax assessment, putting vicinal relation aside, the value of agricultural land is determined by its ability to produce crops. The value of residential land is determined by its ability to support buildings and provide drainage for septic tanks (there is no public sewage system in the

study area).

Provided with a Use Suitability Rating (of Soils in the Study Area) obtained from Linn County Planning Department and published by the Soil Conservation Service, the land's ability to perform either agricultural or residential functions can easily be determined. The agricultural land's suitability is displayed on Figure 3, which includes the top four of the five ratings (Appendix). These top four ratings are very good, good, fair, and poor. The study area's residential land suitability rating (without septic tank) includes only two of the five categories, fair and very poor, and is displayed on Figure 4.

#### Deriving the Value

It is imperative when deriving the value of each individual land parcel that the method by which a given value is determined remains constant. In the Albany area, as in most localities, the only institution that fulfills this requirement is the local (Linn County) assessor. The Linn County Assessor's Office guarantees that the land value assessment is completely unrelated to any improvement (structure) on the land and that the assessed land value is within ten percent of the land's market value.

Use of the assessor's file offers the most complete and comprehensive source of land values. The task of deriving a value for each parcel of land in the study area is of such magnitude that no other

# AGRICULTURAL USE SUITABILITY CLASSIFICATION

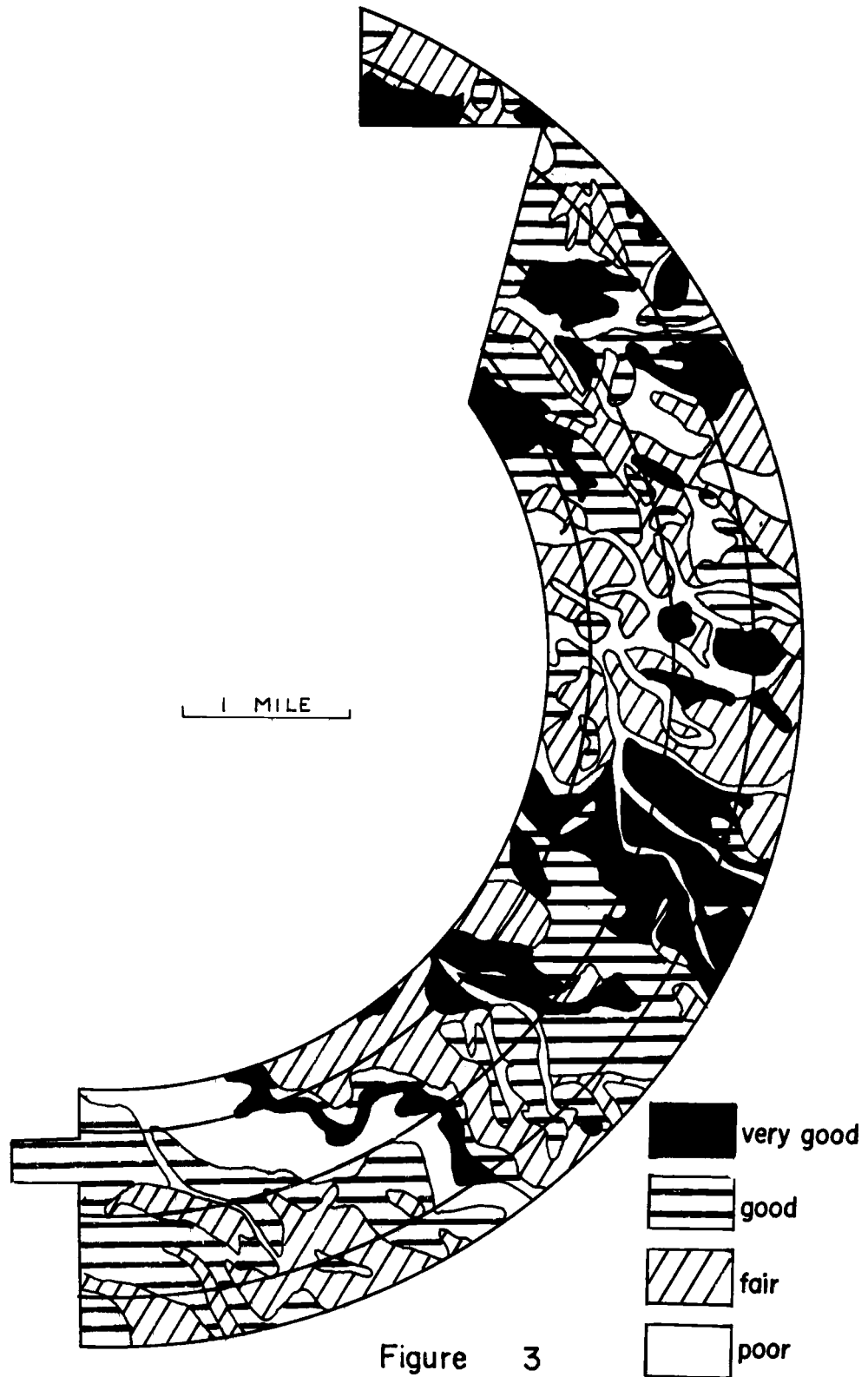


Figure 3



# RESIDENTIAL USE SUITABILITY CLASSIFICATION

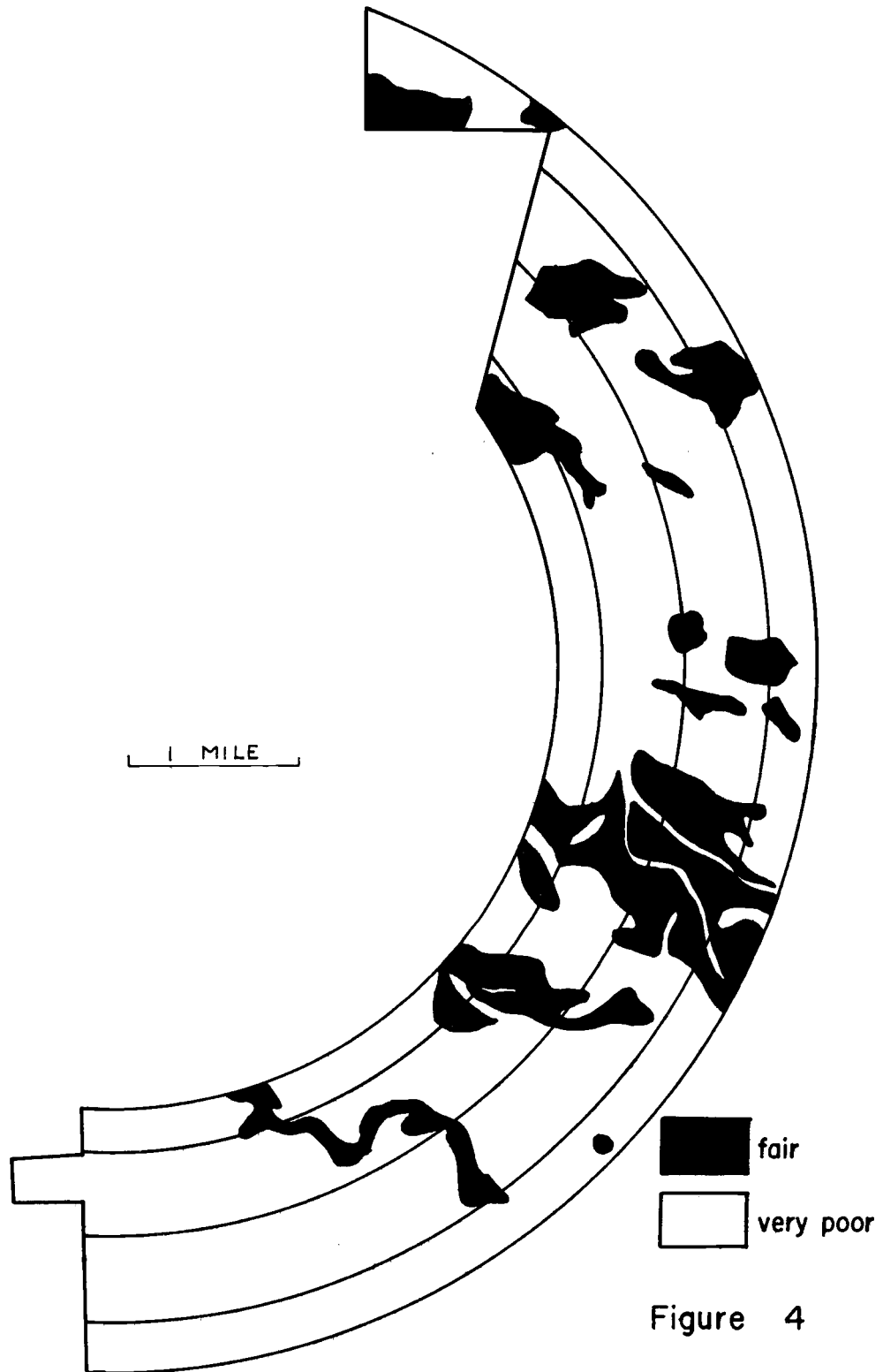


Figure 4

method could be substituted.

When the Assessor determines the value of the land certain guide lines are followed that hinder direct comparison of any two randomly chosen parcels within a given area. The assessor's department, however, has established prescribed categories of land. Any parcel in a given category is comparable as far as taxing methods to any other parcel in that category.

Agricultural land is any parcel over 40 acres, meaning any parcel assessed as agricultural land is comparable to any other assessed as a member of that category. Residential land, (within the study area) is assessed according to three categories prescribed by Linn County's Appraisal Jacket Classification. These categories are as follows:

1. Rural-Residential - approximately 10-40 acres
2. Residential - approximately 1-10 acres
3. Sub-Residential - 1 acre or less.

For the above categories and agricultural land, acreage and land value were obtainable for each parcel from the tax rolls. This allowed easy computation of value per acre. The only parcels that did not have acreage as an item on the tax rolls were lots in a subdivision. In this case the average lot value (taken from the tax rolls) of a given subdivision was used as the comparative base.

The end results of categorical consideration are five separate

and different categories of land: Agricultural (Figure 5), Rural-Residential (Figure 6), Residential (Figure 7), Sub-Residential (Figure 8), and Subdivision (Figure 9). Within each category land values are determined according to the same criteria that allows a comparison of affected parcels with non-affected parcels.

### THE ANALYSIS

In analyzing the data a dual investigation is necessary. First of all each land category must be considered as a separate entity. In other words, each category's evidence must be examined and analyzed to determine if air pollution appears as a value-affecting factor. Second, a composite picture should be noted. It must be determined if on the aggregate scene, considering all classifications, air pollution appears to be a value-affecting factor. By considering all categories in a composite fashion an overview of the analysis can be gained.

#### Agricultural Land

The results of the investigation of land categorized as agricultural, parcels over 40 acres, were as follows:

Total Number of Parcels - N = 48

Percentage of Parcels in Standard Deviation (s) Group,

Affected Area, n = 12

0.0	more than +1s
25%	0 to +1s
75%	0 to -1s
0.0	more than -1s

Non-Affected Area, n = 36

8.4%	more than +1s
55.5%	0 to +1s
36.1%	0 to -1s
0.0	more than -1s

Due to the large segments that comprise the agricultural category, general rather than specific patterns of the land's use suitability rating should indicate any value bias due to productive potential. Figure 3, Agricultural Use Suitability, shows that very good and poor land are divided proportionately between the affected and non-affected areas. The non-affected area has more land in the very good classification than the affected area, but it also has more in the poor classification. Also, the number of parcels of agricultural land that have good or poor use suitability ratings are approximately equal. Despite these general patterns the non-affected area has higher percentages in the positive standard deviation groups as opposed to the negative standard deviation groups, whereas the affected area has seventy-five percent of its parcels below the mean

value for all parcels.

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A comparison of the Agricultural Use Suitability Classification (Figure 3) and the Value of Parcels Over 40 Acres (Figure 5) indicates two factors of primary importance. First, in the affected area a cluster of parcels in the 0 to -1s class corresponds very closely to land classed as very good on the use suitability rating, indicating a discrepancy between land value and its use suitability. Second, the values of the parcels in the non-affected area correspond very closely to their respective use suitability classification. Where exceptions do occur they are of a positive nature rather than a negative; that is, the value tends to be in a class higher than expected from its suitability class. It is for these reasons that agricultural land in the study area indicates that air pollution seems to have a value-depressing effect.

#### Rural-Residential

Land categorized as rural-residential, parcels between 10 and 40 acres, produced the following results:

Total Number of Parcels - N = 44

Percentage of Parcels in Standard Deviation (s) Group,

#### Affected Area, n = 23

26.2%	more than +1s
13.0%	0 to +1s
47.8%	0 to -1s
13.0%	more than -1s

# PARCELS OVER 40 ACRES

(TAXED AS AGRICULTURAL)

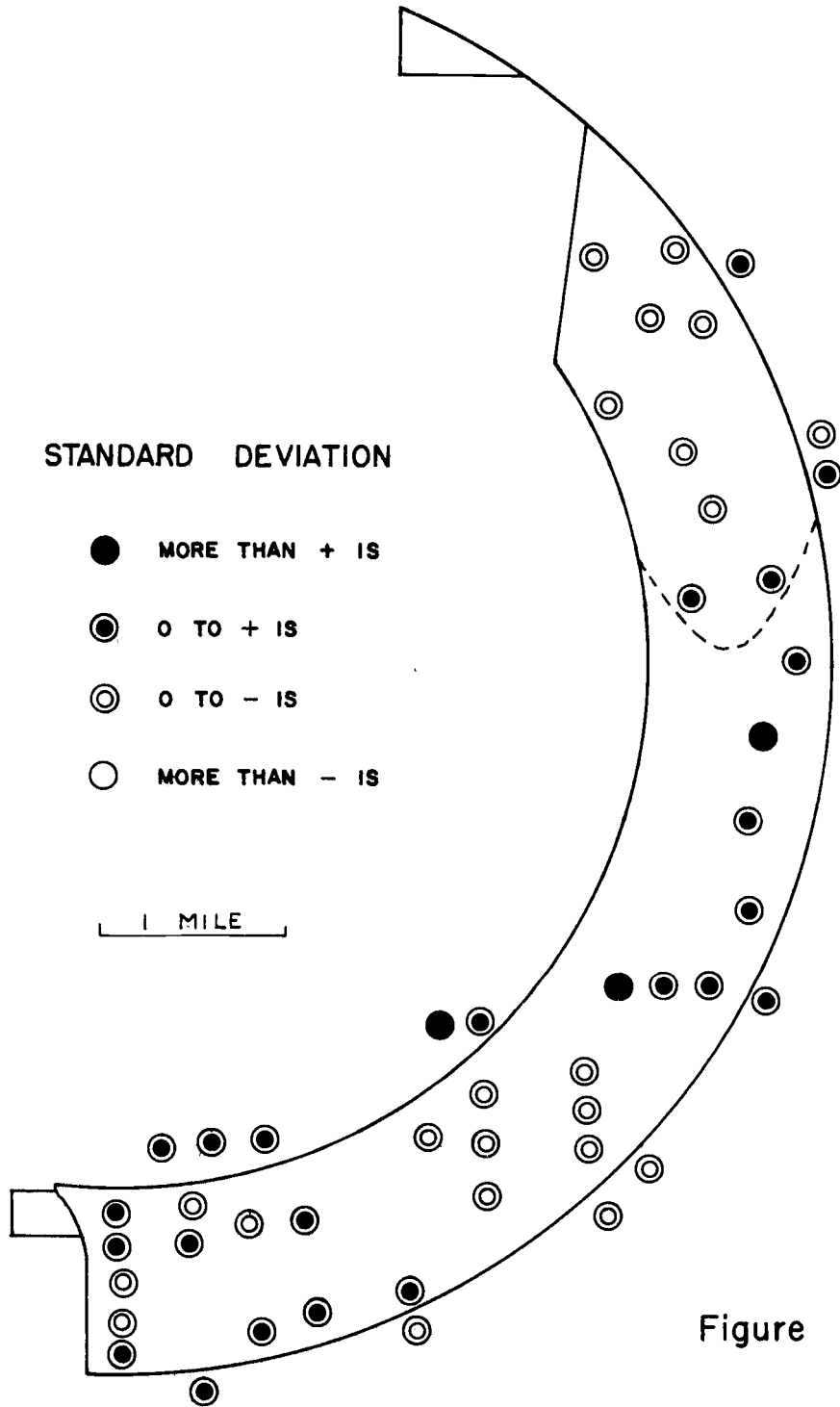


Figure 5

Non-Affected Area, n = 21

9.6%	more than +1s
33.3%	0 to +1s
57.1%	0 to -1s
0.0	more than -1s

The percentage figures give no indication that there is a difference due to pollution between affected and non-affected values. For instance, there are no parcels of non-affected area in the lowest standard deviation class, yet 57.1% of the parcels of non-affected area are in the 0 to -1s category. On the other hand, affected land has 11.5% of the parcels in the lowest class and 23.0% in the highest class. Because of this mixed pattern no firm conclusion can be reached.

Furthermore, when the Parcel Location and Value Class (Figure 6) are compared to the Residential Use Suitability (Figure 4), little correlation, which was present in agricultural land, can be noted. For example, all the more than +1s parcels in the lower left of the affected area are situated within an area of very poor use suitability.

For the most part few of the value-depressing indicators are present in this land use category. There is no evidence that the affected area has an air pollution value-depressing condition.

# PARCELS BETWEEN 10 & 40 ACRES

(TAXED AS RURAL - RESIDENTIAL)

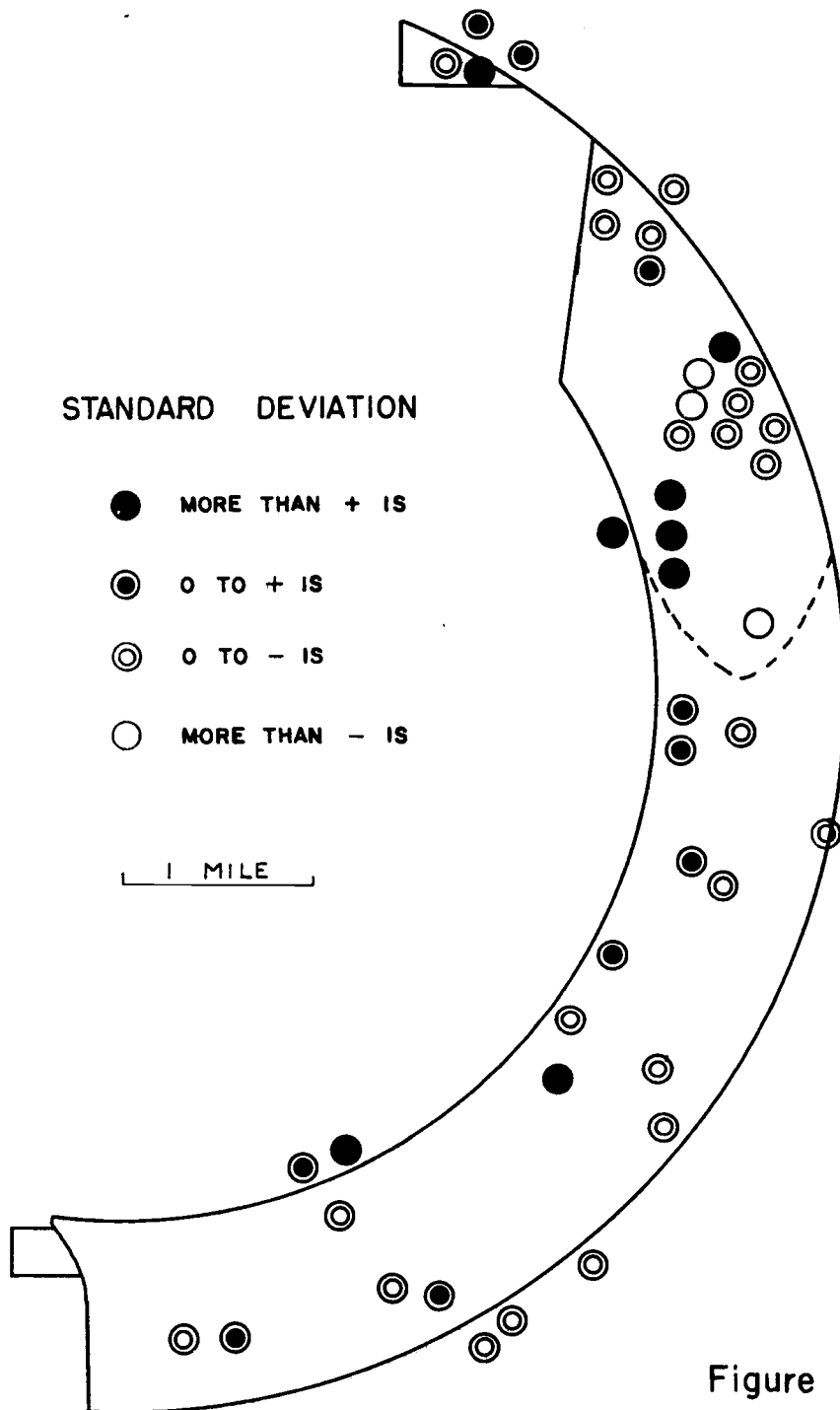


Figure 6



Residential Land

Land under the residential category, parcels between 1 and 10 acres, produced the following results:

Total Number of Parcels - N = 87

Percentage of Parcels in Standard Deviation (s) Group,

Affected Area, n = 43

2.3%	more than +1s
48.8%	0 to +1s
30.2%	0 to -1s
18.6%	more than -1s

Non-Affected Area, n = 44

13.6%	more than +1s
34.1%	0 to +1s
41.9%	0 to -1s
10.4%	more than -1s

The above percentages indicate a result very similar to the preceding category, rural-residential. Although the non-affected area has a higher percentage of parcels in the highest class and a lower percentage in the lowest class, the affected area has a higher percentage of parcels above the mean than does the non-affected area.

A comparison of the Value Map (Figure 7) and the Residential Suitability Map (Figure 4) does not change what the figures indicate.

# PARCELS BETWEEN 1 & 10 ACRES

(TAXED AS RESIDENTIAL)

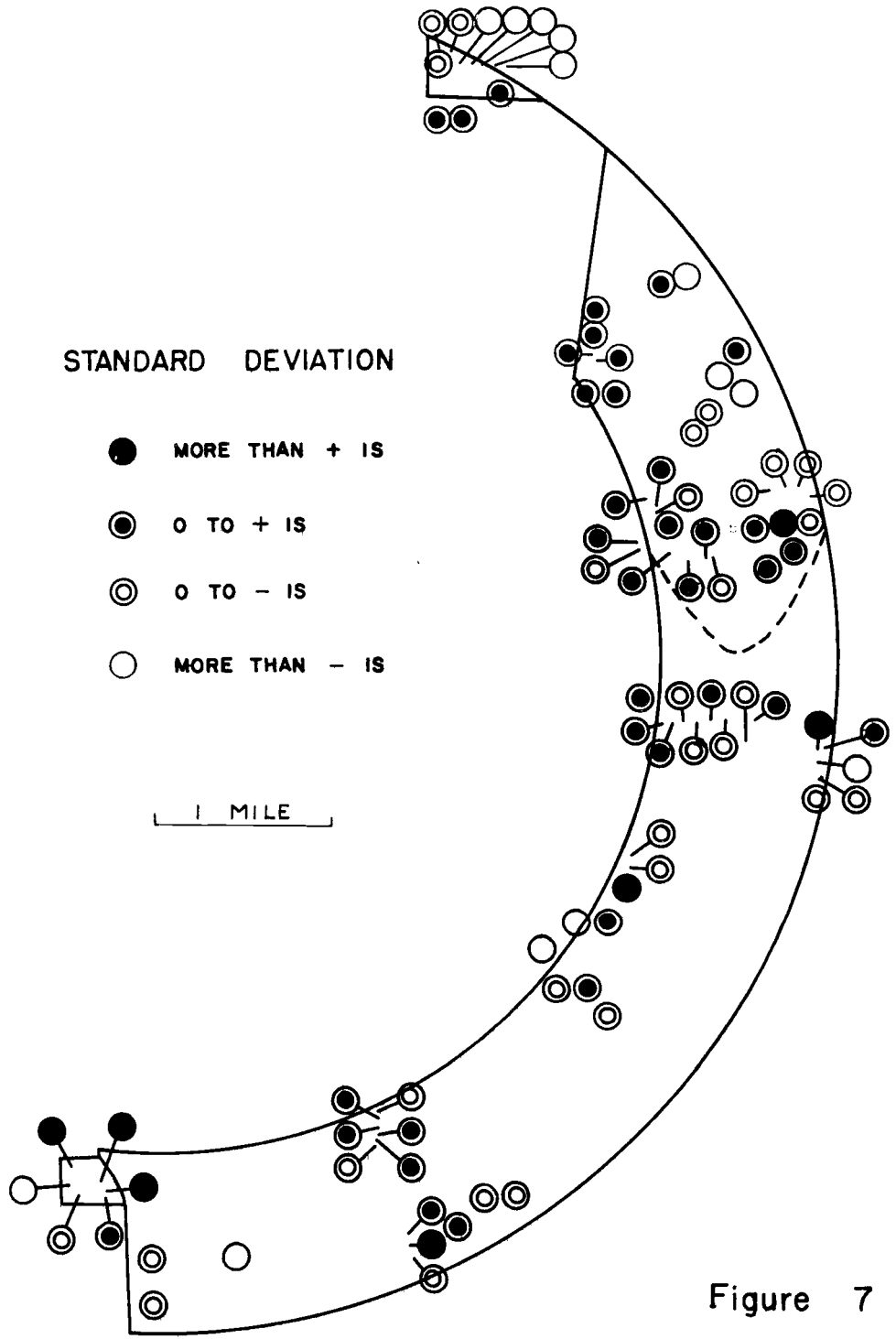


Figure 7

There is no pattern that can be established that will relate land value to suitability and, for that matter, air pollution.

Sub-Residential

An examination of sub-residential land, 1 acre or less, yielded the following results:

Total Number of Parcels - N = 117

Percentage of Parcels in Standard Deviation (s) Group,

Affected Area, n = 78

5.1%	more than +1s
19.2%	0 to +1s
65.4%	0 to -1s
10.3%	more than -1s

Non-Affected Area, n = 39

30.7%	more than +1s
25.7%	0 to +1s
35.9%	0 to -1s
7.7%	more than -1s

The direct percentages in this category indicate a significant difference in value between the two areas. The affected area has more than three-quarters of its parcels falling below the mean value. The non-affected area has 56.4% of its parcels lying above the mean values, with a striking 30.7% above +1 standard deviation (Figure 4).

However, an examination of the Residential Suitability Map in relation to the value map (Figure 8) indicates that a bias is introduced. The great majority of the affected area parcels are located on soil with a very poor suitability rating whereas the non-affected area has nearly half of its parcels located in a slightly higher classification, fair. Whether the slight suitability rating difference has a significant effect on the value is difficult to say; however, the fact that nearly all of the parcels above the mean value are located on land of fair suitability gives some evidence of suitability having a significant effect on value. Assuming then that the suitability is significant, the difference between the percentage of parcels above and below the mean value in the two areas would be negated and therefore no value-depressing factor due to air pollution is evident.

#### Subdivision

Theoretically, subdivided land should present the clearest picture of any value difference due to air pollution since it is most closely related to actual urban living. Land in this category is designated on the tax rolls as Land in Subdivision with no lots larger than one acre and most lots considerably below that area. Since little difference exists in the average lot size of the study area's subdivisions, the average value per lot per subdivision is a more meaningful expression of comparison than value/acre.

# PARCELS 1 ACRE OR LESS

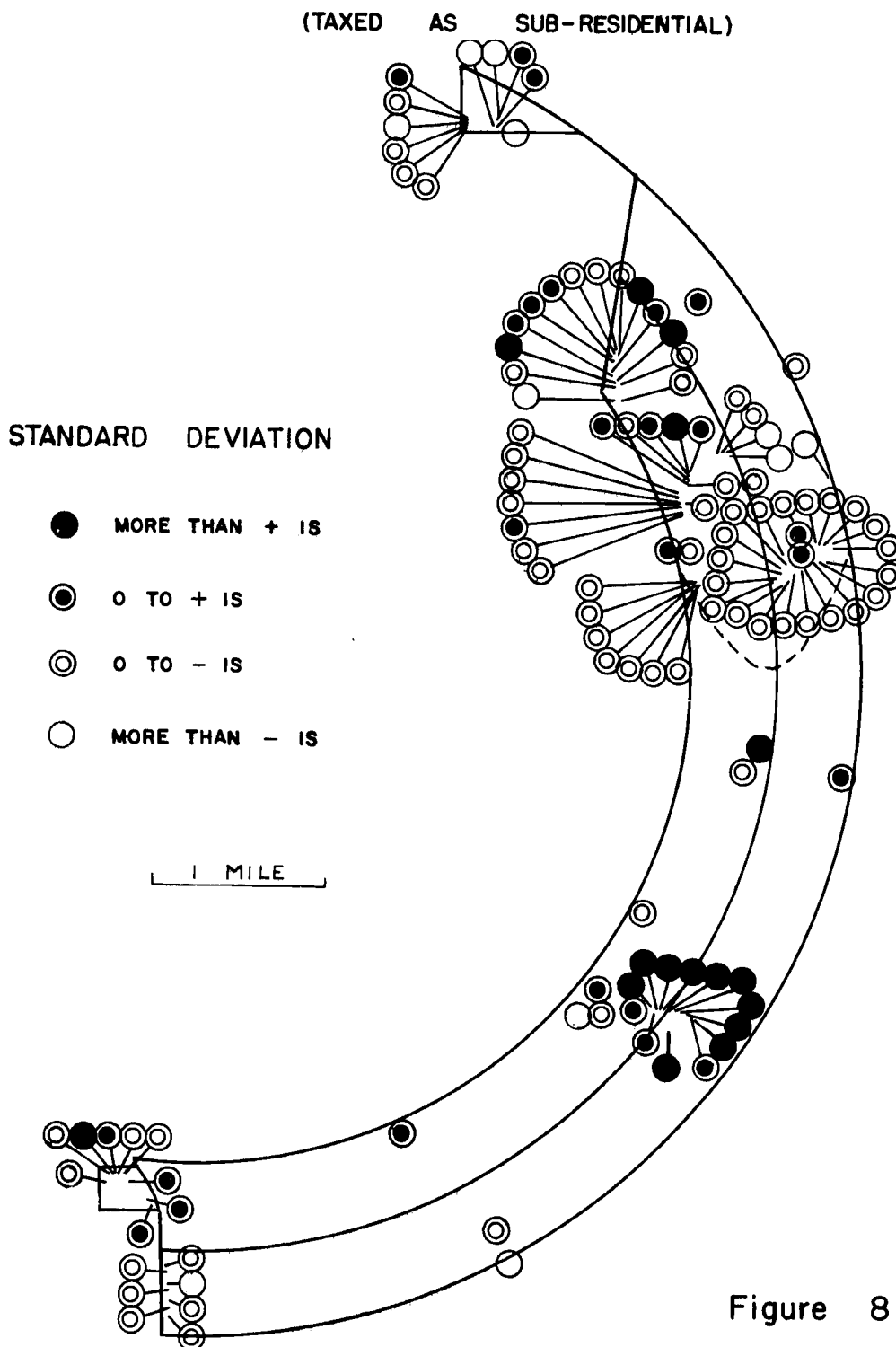


Figure 8

	<u>Subdivision Number</u>	<u>Number of Lots</u>	<u>Mean Value/Lot</u>
Affected			
Area	1	53	\$ 980
	2	18	826
Non-Affected			
Area	3	44	1095
	4	14	981
	5	23	1812

The suitability rating of very poor applies to all the subdivisions with the exception of Subdivision 3, which is rated fair. Even when this one exception is considered, however, the values indicate that considerable difference does exist between the two areas that could be related to air pollution (Figure 9).

To conclude such without two additional considerations would be a mistake. An important factor to consider is land value in relation to improvement value but this topic will be dealt with in greater depth in the Aggregate Analysis. The second item which should be mentioned is that of subdivision design. Subdivisions 1, 2, and 4, those of lowest value, are all of the more traditional grid pattern with few limits on road access. Subdivisions 3 and 5 are of a more modern irregular pattern designed for greater visual amenity and have limited circulation access.

#### AGGREGATE ANALYSIS

The composite picture that is gained by weighing the meaning of all five categorical results is one of "no conclusive effect."

# PARCELS WITH NO ACREAGE DESIGNATED

(TAXED AS SUBDIVISION)

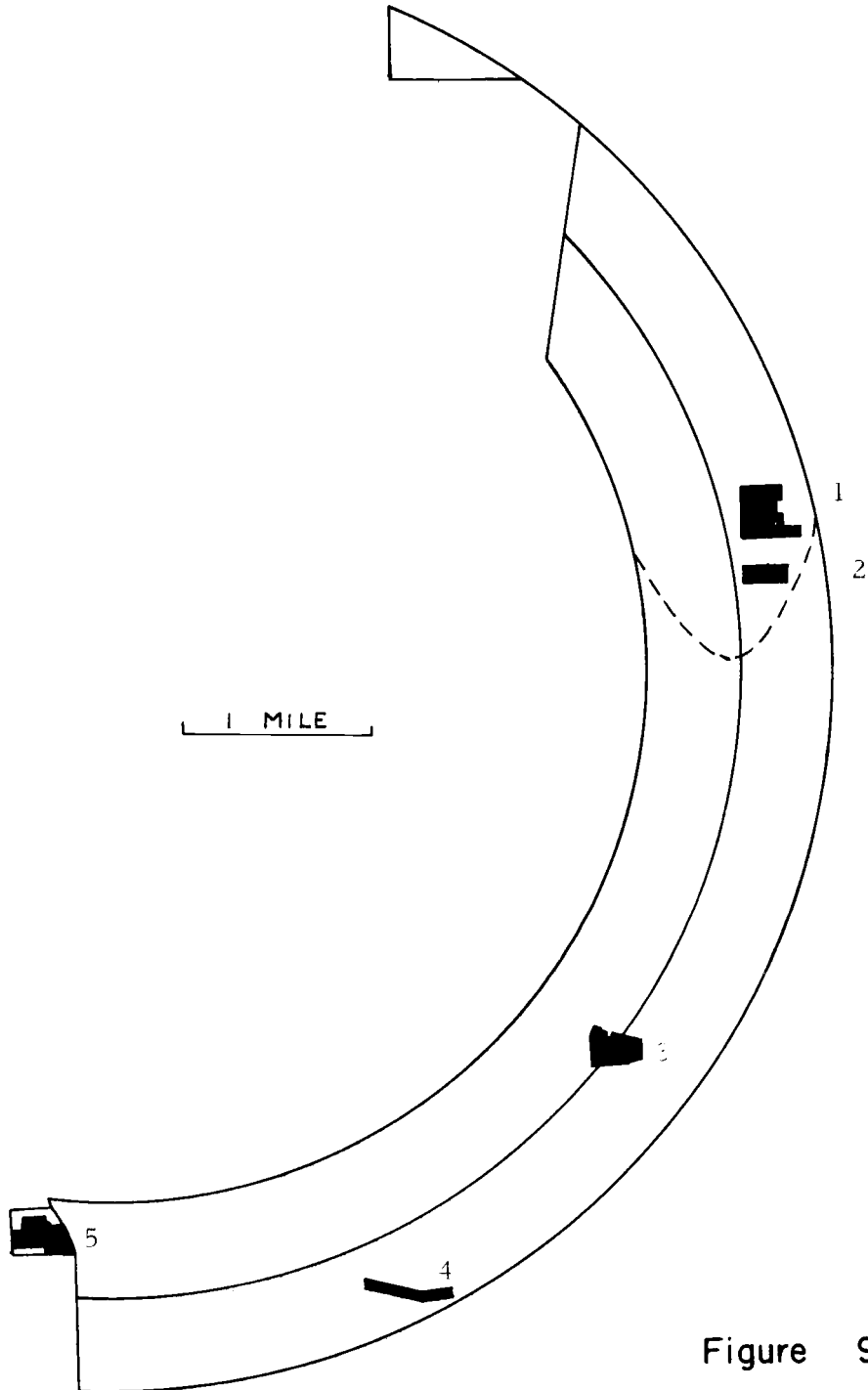


Figure 9

Although there is a trace of evidence in the agricultural and sub-division categories that air pollution does have a depressing effect on land values, it is neither decisive enough nor overwhelming enough to counteract the negative results from the three remaining categories.

Other than the evidence itself there are two additional factors that add reinforcement to the above conclusion, and also make the assessor's guarantees rather dubious.

1. The agricultural land category, which has the most solid evidence of value depression in the affected area according to the study, has the least theoretical justification.

2. The value/lot of each of the five subdivisions seems to correlate closely to both design and improvement value. The subdivisions with more modern designs and more expensive homes have the higher value/lot.

In retrospect, certain observations have been made that make the entire validity of the value deriving method doubtful. These observations can be summarized as follows:

1. It is questionable whether the assessor's guarantee that land value is determined separate from improvement value is fact. Both the improvement values on the tax rolls and a field observation indicated a strong correlation of land value with improvement value in residential land.

2. It is also doubtful whether the assessed value is within ten



percent of the market value, another guarantee of the assessor. Two large agricultural parcels have recently been sold at nearly three times the assessed value.

3. Whether the individual assessor actually considers air pollution as an ingredient in deriving a market value and thereby an assessed value is also doubtful.

### CONCLUSION

The study has failed to reach an undisputable result whether air pollution in the study area did or did not affect land values. On the other hand, this study has displayed both a new method of investigation and also some of the more renowned obstacles in developing a methodology. A method is only as reliable as the available data, which in this case is apparently not too reliable. The researcher is tied to a value assessment system which has consistency and total coverage but which also has too many destructive elements. There is no true guarantee of value relations and/or proper assessment, and there is the unpredictability of human response to nuisances. The human element of judgement could have even more far-reaching effects than simply biasing the assessed value. A most important item that Mr. Chock discovered in his survey is that nearly half of the entire group surveyed did notice an air condition improvement during the past few years. This belief that the entire condition,

assuming one does exist, could be removed in the near future might possibly have a diluting effect on a formula previously aimed at depressing value.

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2. Nourse, Hugh O. "The Effect of Air Pollution on House Values," Land Economics. Volume 43, No. 2, May, 1967.

## FOOTNOTES

1. Nourse, Hugh O. "The Effect of Air Pollution on House Values," Land Economics. Volume 43, No. 2, Page 181, May, 1967.
2. Ibid. Page 182.
3. Ibid. Page 187.
4. Ibid. Page 189.
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7. Nourse, Hugh O. "The Effect of Air Pollution on House Values," Land Economics. Volume 43, No. 2, Page 187, May, 1967.
8. Oregon State Sanitary Authority, Division of Oregon State Board of Health, Portland, Oregon, March 12, 1968. Interview with C. A. Ayer.
9. Ibid.
10. Linn County Assessor's Office, Albany, Oregon, March 13, 1968, Interview with Bud Crosby, Linn County Appraiser.
11. Appraisal Jacket Classification. Linn County Assessor's Office, 1968.

## APPENDIX

## APPENDIX

Table I. Use Suitability Ratings of Soils (in Study Area Soils)

Series, Type and Phase	Agricultural	Residential with Septic Tank
Amity silt loam	Good	Very poor
Courtney clay	Poor	Very poor
Camas gravelly loam	Poor	Very poor
Clackamas gravelly loam	Fair	Very poor
Chehalis silty clay loam	Good	Very poor
Dayton silt loam	Fair	Very poor
Dayton silty clay loam	Poor	Very poor
Holcomb silty clay loam	Fair	Very poor
Holcomb silt loam	Fair	Very poor
Salem clay loam	Good	Fair
Willamette silt loam	Very good	Fair

Very good - The soil presents no limitation to the use in question.

Good - The soil presents minor limitations to use. The limitation is easy to overcome.

Fair - The soil presents moderate limitations. The limitations need to be recognized but can be overcome or corrected.

Poor - The soil presents serious problems and has severe limitations to use which need to be recognized. Use tends to be questionable as the limitations are hard to overcome.

Very poor - The soil presents such severe limitations to use that extreme measures are needed to overcome the problems. Usage tends to be undesirable or unsound.