THE EFFECTS OF ZONING ON LAND USE PATTERNS: A COMPARATIVE CASE STUDY

by

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The Effects of Zoning on Land Use Patterns: A Comparative Case Study

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Since zoning is the principal land use control which physical planners have at their disposal, it is important that knowledge about the consequences of its exercise be as complete as possible. The purpose of this thesis is to make a small contribution toward such knowledge through an exploratory study of the actual effects of a particular zoning regulation on two suburban towns within the Boston metropolitan area - Lexington and Needham, Mass.

There are a variety of types of effects which zoning controls might have - physical, social, economic, demographic, etc. - as well as a variety of methods by which the effects might be studied. This thesis concentrates on one type of effect - physical. The term "land use pattern" is used to describe the kinds of physical consequences of interest here. And a "land use pattern" is defined as a combination of the spatial location of activities and adapted space. The final delineation of the focus of interest for the thesis was made by selection for study of particular aspects of land use patterns - density and generalized spatial distribution (gross pattern); and selection of a relevant zoning regulation, minimum residential lot size controls. The method of approach chosen was to construct a frequency distribution of the lot sizes occurring in subdivisions platted in Needham and Lexington following the adoption of zoning by-laws in the 1920's; and then to attempt to explain the emergent pattern of deviations (if any) above the legal minimum lot size.

In choosing Needham and Lexington as sample towns, the limitations of such a small sample were recognized, and an effort was made to hold constant a number of important variables (rate of growth, economic and social characteristics, etc.). The lot size regulations of the two towns were considered of interest since Lexington had consistently upgraded its minimum lot requirements since 1924, adopting only in 1954 two lot sizes; whereas Needham had made only one major revision of its requirements, in 1941 - at which time the town was divided into two lot size zones (one with a one-acre minimum).

The effects of the minimum lot size zoning regulations were clearly seen in the positively skewed shape of the frequency distributions constructed, as well as in the successive upward shifts of the modal lot size to the legal minimum with each zoning change. The average lot size, moreover, was consistently
ABSTRACT

higher than the legal minimum, as a large proportion of the lots in any period were usually above that minimum.

A number of possible explanations for these deviations were offered. Topography, shape of property and frontage requirements - three physical and legal factors - were viewed as affecting primarily the length and variability of the tail of the distribution. Social and economic pressures, however, were presented as operating principally on upward shifts in the modal lot size in successive periods. The lot size distributions were then examined for evidence as to whether modal lot sizes might have risen without assistance from increased legal minimums. In both towns, especially during the 1930's, the behavior of the relative percentages of lots at or near the modal size lent support of this possibility, although the total picture was not conclusive. Differences between the two towns (and lot size zones in each) as to degree of central tendency in the distributions and proportion of lots at the legal minimum brought out the possibility that one type of economic pressure - rate of subdivision - might operate to increase the concentration at a given legal minimum. Pre-zoning data in Lexington was presented as providing an example of one way in which the question of whether and how modal lot sizes would have risen without assistance from zoning controls might be fruitfully investigated.

In the chapter on gross pattern, the coincidence of the boundary of Needham's one-acre zone with the boundary of the main pattern differentiation within the town was noted. An explanation of this phenomenon revealed the particular local factors which made it possible; and it was suggested that similar early adoption by Lexington of two lot sizes (one large, as in Needham) would probably have had relatively little effect in producing a pattern differentiation comparable in sharpness to Needham's, due to the nature of early subdivision activity in Lexington, as well as to basic differences in physical form, circulation systems, etc., in the two towns. The possible influence of patterned lot size zoning on gross pattern was seen as definitely limited by the important of such factors.

Finally, a variety of suggestions were made for further research into the consequences of zoning, in particular with respect to minimum lot size regulations and the concept of grain. The value of investigating the effects of zoning was restated; and its use in clarifying the consequences of alternative courses of action - regardless of the particular community goals involved - was emphasized.

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# Table of Contents

I. Introduction  
1. Types of Consequences  
2. Types of Study Approaches  
3. The Land Use Pattern  

II. The Choice of Sample Communities  
1. Problems of Selection  
2. Characteristics of Towns Selected  
3. The Zoning Regulations  

III. Results of the Lot Size Study  
1. Data Sources and Problems  
2. General Characteristics of the Frequency Distributions  
3. Explaining the Deviations: Physical and Legal Factors  
4. Social and Economic Factors  
5. Pre-zoning Data  
6. Summary  

IV. Analysis of Gross Pattern  
1. Description of the Patterns  
2. Relationship to Lot Size Regulations  
3. Summary  

V. Suggestions for Further Research  
1. Minimum Lot Regulation Studies  
2. Zoning and Grain Analysis  
3. Concluding Remarks  

Appendix - Problems of Data Collection  

Bibliography
List of Tables

Tables 1-21

Table 1 - Population Changes, Building Permits Issues, Income Distribution in Lexington and Needham

Table 2 - Occupational Distribution, and Selected Housing Characteristics in Lexington and Needham

Tables 3-9 - Percentage Lot Size Distributions, Lexington

Table 3 - 1924-29 and 1929-38, Lexington
Table 4 - 1929-34 and 1935-38, Lexington
Table 5 - 1939-45 and 1946-50, Lexington
Table 6 - 1939-50 and 1951-53, Lexington
Table 7 - 1954-61, Lexington
Table 8 - 1954-61, Lexington
Table 9 - 1960-61, Lexington

Tables 10-16 - Percentage Lot Size Distributions, Needham

Table 10 - 1925-40, 1925-29, and 1930-40, Needham
Table 11 - 1941-60, Needham
Table 12 - 1941-60, Needham
Table 13 - 1941-49, Needham
Table 14 - 1950-60, Needham
Table 15 - 1960, Needham
Table 16 - 1960, Needham

Table 17 - Number of Lots Counted by Period, Needham and Lexington

Table 18 - Percentage Lot Size Distributions, Lexington: Pre-zoning

Table 19 - Percentage Lot Size Distributions, Lexington and Needham: Pre-zoning

Table 20 - Percentage Lot Size Distribution, Lexington: Lots separated by subdivisions now in 30,000 and 15,000 sq. ft. zones, 1946-50.

Table 21 - Percentage Lot Size Distribution, Lexington: Lots separated by subdivisions now in 30,000 and 15,000 sq. ft. zones, 1951-53.
List of Graphs

Graphs 1-13
Graph 1 - Lexington, 1924-29, Lot Size Distribution 108
Graph 2 - Lexington, 1929-38, " " " 109
Graph 3 - " , 1939-50, " " " 110
Graph 4 - " , 1951-53, " " " 111
Graphs 5A & B - " , 1954-61, " " " 112-113
Graph 6 - " , 1960-61, " " " 114
Graph 7 - Needham, 1925-40, Lot Size Distribution 115
Graph 8 - " , 1925-29, " " " 116
Graph 9 - " , 1930-40, " " " 117
Graphs 10A & B - " , 1941-60, " " " 118-119
Graph 11 - " , 1941-49, " " " 120
Graphs 12A & B - " , 1950-60, " " " 121-122
Graph 13 - " , 1960, " " " 123

Maps I - IV
Map I - Metropolitan Location of Needham and Lexington 124
Map IIA - Land Use, Needham 125
Map IIB - Land Use, Lexington 126
Map III-A - Zoning, Needham 127
Map III-B - Zoning, Lexington 128
Map IV-A - Location of Subdivisions, Needham 129
Map IV-B - Location of Subdivisions, Lexington 130
I. Introduction

Zoning is the principal land use control which physical planners have at their disposal. As such, it is of obvious importance that wherever feasible the consequences of its exercise be determined. For the successful revision and improvement of zoning regulations to achieve community objectives undoubtedly depends on knowledge of possible consequences, and is limited where such knowledge is lacking. Such limitations are not necessarily fatal, of course, and an educated guess may as often be correct as not. But, nonetheless, there can be few objections to improving the existing state of knowledge as to the consequences of zoning.

The purpose of this thesis is to make a small contribution toward that end through an exploratory study in two communities of the actual effects of a particular zoning regulation. For a moment's thought will show that "zoning" is not a homogeneous category, and different zoning policies, or different aspects of zoning regulations, may have different consequences. Similarly, one can distinguish different types of effects or consequences which zoning controls may have. It is relevant here briefly to outline these different types of effects, and various approaches to their study. For it was within this context that the particular problem to which this thesis is devoted was selected.

1. Types of consequences

In general one can identify for analytic purposes six broad categories of consequences. They are listed below, with relevant examples.
1) physical (e.g., effects on land use pattern and circulation system)
2) demographic (e.g., rate of growth)
3) economic (e.g., value of construction)
4) social (e.g., class homogeneity)
5) political (e.g., status of individual rights)
6) aesthetic (e.g., monotony of uniform appearance)

For each type of consequence, different regulations within a zoning ordinance or by-law may be of greater or lesser relevance. An a priori assumption here may prove inaccurate, however; and multiple effects are always possible, indeed likely. But in any case, each type of consequence must be thoroughly analyzed in order to provide concepts of operating significance for research.

2. Types of Study Approaches

The choice of an approach is likely to be influenced by the decision to analyze a particular category (ies) of effect (s), since in a given instance a particular method may be most appropriate. At least four possible approaches are distinguishable, the first two of which (as listed below) are more comprehensive and general than the latter two:

1) the "goal-satisfaction" method (e.g., have the objectives sought by a town in its zoning regulations been achieved?)

2) The "decision-making" method (e.g., in the operation of a zoning ordinance, how are certain enforcement decisions made?)

3) a "minimum requirements" method (e.g., to what extent are certain specified zoning minimums exceeded?)
These four approaches are not exclusive. They may in fact be supplementary at different stages of analysis or with different purposes in mind. It is useful, however, to keep them distinct since they are essential guides in determining the relevance and selection of material to be analyzed.

Given a limited amount of time, it is obvious that one could not study all the possible effects of all the different aspects of a zoning ordinance or set of ordinances within a town (city) or group of towns. Moreover, certain types of consequences may be more difficult to isolate than others, and thus require a longer analysis. This study, therefore, will be confined to a consideration of particular physical consequences - the effects of the zoning requirements of two selected towns on certain aspects of their land use patterns - and it will use, primarily, a method of measuring deviations from minimum standards.

3. The Land Use Pattern

To state the general focus of this study is only a beginning, however; and a further analysis of the concept "land use pattern", in particular, is an essential prerequisite to a clear formulation of the problem. What are the components of a land use pattern?

Lynch and Rodwin, in their article "A Theory of Urban Form", 1

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develop a set of categories which allow generalized description of the physical and activity pattern of a specified area. Distinguishing between spatial location (of activities or of "adapted" space) and flows (of activities, or the flow system itself), they propose six descriptive categories: element types, quantity, density, grain, focal organization, and generalized spatial distribution (gross pattern).²

A land use pattern, then, can be regarded as a combination of the spatial location of activities and adapted space. And it is a phenomenon which can be described, presumably, with use of the six categories listed above. The question can then be put: What regulations in a zoning ordinance or by-law affect location of activities, adapted space, or both? And which components of activity and adapted space location - element types, quantity, density, grain, etc. - are affected by which regulations? The same questions might be asked with respect to the flow system and activity flows.

The answers to these queries will depend to some extent on the Rodwin-Lynch scheme, and would agree with them that "Only systematic testing in real cities will indicate whether all the important features (of physical form at the city scale) are included." (p. 206).

2. Element types, quantity and density are familier. "Grain" is the "extent to which these typical elements and densities are differentiated and separated in space and can be defined as coarse or fine..."; "focal organization" is the "spatial arrangement and interrelation of the key points in the total environment"; and "gross pattern" refers to such things as city "outline...and the broad pattern of zones occupied by the basic element and density types." Definitions taken from Lynch and Rodwin, op. cit., pp. 205-6. For each of these categories, of course, one needs a technique for measurement (of "grain", e.g.), for classification (for activity and adapted space types, e.g.), etc.
the nature and wording of particular zoning regulations. But, without going into great detail or an exhaustive enumeration of possibilities, it may be briefly answered that (for example):

1) The variety of types (uses) permitted by a zoning law naturally controls the types of activities occurring in different parts of a community. Types of adapted space, however, are only directly regulated by provisions such as, e.g., architectural controls. Otherwise the control on adapted space is usually indirect, through the habitual or traditional association of certain types of adapted space with certain activities.

2) Quantity of adapted spaces or activities is usually not directly regulated by zoning (e.g., only "x" number of selling activities are allowed in this community), but will be indirectly affected by density regulations (e.g., total quantity of single-family dwelling types is limited by lot size requirements and total land capable of being so developed).

3) Density of activities and adapted space (usually stated in the combined form, e.g., of "dwelling structure") is directly regulated by lot size minimums, floor-area ratios, open space requirements, height limitations, etc.

4) Grain of activities will be affected, though not directly regulated, by the sizes of the different use districts and their location with respect to each other; by the exclusive or cumulative form of a zoning law; and by policies with respect to special permit and non-conforming uses. Grain of adapted space will be affected by zoning insofar as certain types of structures are habitually used for certain types of activities, and are assumed to be so used in the zoning law.

5) Focal organization is not usually explicitly regulated by zoning (i.e., in so many words). But it is definitely affected by the spatial arrangement, for example, of uses and density districts.

6) Generalized spatial distribution, or gross pattern, will also be affected by shapes, sizes and arrangements of use and density districts under the zoning law, particularly the latter.

7) The flow system and activity flows are not usually directly regulated by zoning (e.g., only so many streets may be built in this area, and may be used by only so many people per hour); but their nature and use is indirectly affected by zoning controls.
7) over density and location of activities. Road-side land use controls may have a special status here.

Two points emerge clearly from the above list of suggestions: 1) Certain components of land use patterns are commonly explicitly or directly regulated by zoning, while other ordinarily are indirectly affected (though not by theoretical necessity); and 2) Activities and physical form (adapted space) are usually combined in the terminology of a zoning ordinance. On the latter point, for instance, permitted uses in a "residential" district are usually described as "one-family dwellings", "churches", "schools", etc.; but it is not usually explicitly stated that a family may not build and live in what is commonly considered a "store" (adapted space for buying and selling).

With these considerations in mind, I chose to examine in two selected towns the effects on density (primarily) and on gross pattern (secondarily) of a particular zoning regulation: minimum lot size requirements for "residential structures". Such controls are a direct regulation of density and by nature lend themselves to use of the "minimum requirements" method mentioned above. For where physical quantities are involved (square feet in this case) deviations above a legal minimum can be fairly precisely estimated, a frequency distribution.

3. In part, this is a matter of convenience in wording. But it suggests that zoning is usually concerned principally with controlling location of activities, not types of adapted space. The difficulty with regulating location of types of adapted space (as distinguished from building specification as in a building code) is that adapted spaces have many possible uses. Technological change (e.g., as in factory design) could make such regulations quickly obsolete (to say nothing of changes in taste).
constructed and analyzed, and the actual market response to the zoning requirements thereby described.

Explanation for any particular pattern of deviations from the minimum (both within and between towns) can be attempted, however, only with reference to factors which influence the decision of a subdivider to plat his land in a certain fashion. Logically this would require use of (at least) a decision-making approach. The minimum requirements analysis here may thus be viewed as primarily descriptive and suggestive. It can reveal an empirical phenomenon (the frequency distribution of size of lots platted). But it does not in itself provide an explanation of the phenomenon.

A rigorous explanation will not be possible in this thesis for two basic reasons. First, the sample used (two towns) is not large enough to get reliable correlations between patterns of deviation from minimum lot sizes and factors influencing that pattern, e.g., economic and social characteristics of the communities studied. Secondly, insufficient time was available in any case to make a detailed follow-up analysis, e.g., questionnaires to developers, or careful inspection of sites platted. This does not mean, however, that the problem will be ignored. Suggestions will be made as to reasons for different deviation patterns and hypotheses which might be further investigated will be advanced. The analysis of gross pattern will consist primarily of an attempt to place the effects of the pattern of lot size zoning in the context of relevant determining factors.

These reflections will be clarified further in the course
of the thesis. They are set forth here principally to indicate the attempted scope of the task, and to suggest that this study should be regarded as explorative and a chart for further work. The following chapters, therefore, will deal with: 1) The towns studied: problems of selection, and characteristics of the towns; 2) The results of the lot size analysis, with suggestions in explanation of the outcome; 3) The gross pattern of the towns in light of the lot size analysis and other factors affecting town development; and 4) Suggestions for further research.
II. The Choice of Sample Communities

1. Problems of Selection

The choice of a general approach and a focus of interest is crucial. But with that basic decision having been made, many problems still remain. In particular, data gathering rules, and selection of sample towns are of prime importance.

Ideally, perhaps, one would select for study communities both with and without zoning, so as to maximize the chances of separating out other factors affecting land use patterns from the effects of zoning. In practice, however, one is likely to be concerned with a particular zoning provision (or group of provisions) rather than with the whole ordinance or by-law (and all of its possible effects). Therefore, a meaningful comparison can be made by selecting two (or more) zoning laws with different policies (or specifications) as regards a particular type of regulation. This approach is more feasible when one's laboratory for study is a major metropolitan area where virtually all the towns experiencing significant development have had zoning by-laws for a considerable period of time.

Even if this were not the case, however, more general problems of comparability would condition the choice of study towns. For instance, it is not clear that a comparison between a slow-growing rural town on the metropolitan fringe (without zoning controls) and a fast-growing town at the crest of the present wave of outward development (but with zoning controls) would allow accurate conclusions as to the effects of, for instance, minimum lot size regulation. For other variables, e.g., rate

4. See Appendix (Problems of Data Collection).
of development, social structure, economic structure, position in metropolitan area, etc. - variables which are always present - might in this case dominate the results. This is not to say that the results would have no interest. Rather the point is that if time were available one might take, for example, two or more towns from at least three positions in a metropolitan area (inner, middle and outer bands). Comparisons could then be made between the effects, say, of minimum lot size requirements (which would vary too) on towns with similar and towns with differing position and characteristics.

To undertake such a study would require a minimum sample of six towns, and probably more if one had refined indices or tests for estimating similarities and differences between towns. As such, it was an undertaking beyond the time and resources available for this thesis. Therefore, the decision was made to choose two towns in the metropolitan Boston area, attempting insofar as was possible to hold constant the variables mentioned above.

2. Characteristics of Towns Selected

The two towns chosen were Lexington and Needham. Both are approximately the same distance from central Boston, and in the western sector of the metropolitan area. (See Map I, p.124.) Both towns are located on the circumferential highway (Rt. 128). A major radial, Rt. 2, passes through Lexington, while Rt. 9, another principal radial, runs just to the north of Needham.

Lexington and Needham have experienced heavy development
since the war\textsuperscript{5} and are among the fastest growing towns in the Boston metropolitan area. Since 1910, moreover, the two towns have had similar, though not identical, population growth rates (though recently Lexington has begun to grow somewhat more rapidly). See Table 1, p. 87.

In both towns, single family residential uses predominate. In 1950 over 80\% of the dwelling structures in Lexington and Needham were one-family unit, detached. See Table 2, p. 88. A glance at the accompanying land use maps (Maps II-A, II-B, pp.125-6) will show, however, that more industry exists at present in Needham than in Lexington. In part this is due to the fact that throughout the 19th and early 20th centuries, Needham had many small industries (e.g., paper, knit goods, glue, shoes, et al), located mainly in the eastern part of the town (Needham Heights), some of which (or their successors) remain today.\textsuperscript{7} In the 1950's, moreover, Needham decided to allow land to be zoned for an industrial park (the New England Industrial Center) near the interchange of Rt. 128 and Highland Ave. (See Map III-A) The park has flourished and industrial activity.

\textsuperscript{5} In fact, Lexington and Needham were among the 11 towns in Massachusetts which had a net in-migration of over 5,000 persons during 1950-60 (7,386 and 6,744 respectively). See Population Movements in Massachusetts, 1950-60, Massachusetts Dept. of Commerce (Jan. 1961).

\textsuperscript{6} The Greater Boston Economic Study Committee's 1960 Land Use Acreage study shows 13 acres of land in Lexington in manufacturing or wholesale uses, with 106 under development (out of a total of 10,650 acres); and 217 acres in Needham in the same uses, with 31 under development (out of a total 7,998 acres). Data taken from GBESC files.

\textsuperscript{7} See Monograph #89, Town and City Monographs, Massachusetts Dept. of Commerce, for a description of early industry in Needham.
in the eastern section of the town has increased. Lexington, on the other hand, although it had some small industries in the past (grist and saw mills, past factory, fur articles, et al), remained predominantly agricultural, and even today has more nurseries, truck gardens, etc., than are to be found in Needham.

In the 1950's, with the opening of Rt. 128, the town has wrestled with the problem of whether to allow industry into Lexington. Thus far it has zoned land near the Rt. 128 interchange with Rt. 2 for research and office uses, and near the interchange with Bedford St. for light manufacturing. (See Map III-B, p. 128.) For various reasons, however, industrial development has not been on the scale of the Needham New England Industrial Center.

All this is not to say, however, that Needham is a "working-class" community. Few of the employees at the New England Industrial Center live in Needham, according to the Rt. 128 Study. And figures on income and occupational distribution (for 1950) indicate strong similarities between the two towns. (See Tables 1-2, pp. 87-8). Needham, moreover, has long contained many private country estates, located along the Charles River, for the most part, in the southern and western portions of the town.


9. Some of the reasons are discussed in Economic Impact Study of Massachusetts Route 128, Dept. of Civil and Sanitary Engineering and Transportation Engineering Division, Massachusetts Institute of Technology, Dec. 1958, p. 107-9, and p. 177 ff. In this report, Needham and Lexington are given special attention. Lexington does have, however, the Lincoln Laboratories, a major research center and large employer.

10. Ibid., p. 177 and p. 213.
of the town. This may account for the higher percentage of one-
dwelling-unit structures values over $15,000 in Needham than in
Lexington, although the median value is almost the same. (See
Table 2.)

The intention behind the foregoing observations is not to
claim that Lexington and Needham are identical, but rather to
indicate the presence of basic and important similarities. The
measures used in the comparison are rough, but may be adequate
in an exploratory study. The point, in any case, is not to
achieve complete similarity, but to avoid profound differences
in important respects.

3. The Zoning Regulations

An additional criterion for selection of towns was the
nature of the minimum residential lot size regulations, and
their modifications over time. Both Needham and Lexington
adopted zoning by-laws in the 1920's (1925 and 1924 respec-
tively). And in both towns, the original minimum lot require-
ments have been altered several times since.

In Lexington, the minimum enacted in the 1924 by-law was
5,000 square feet (50' frontage) for R1 and R2 districts.
Since then it has been successively upgraded to: 7500 sq. ft.
(75' frontage), 1929-1938; 12,500 sq. ft. (100' frontage),
1939-1950; and 15,500 sq. ft. (125' frontage) 1951-53. In
1954, for the first time, the town adopted two lot sizes, with
a center vs. periphery pattern: 15,500 sq. ft. (125' frontage)
in a defined inner area, and 30,000 sq. ft. (150' frontage) in a
defined outer area. (See Map III-B.) These requirements have not been altered since 1954.

In contrast to Lexington, Needham has had only one major upgrading and the town early (1941) adopted a lot size pattern, with two different minimums. The original residential lot minimum, in the 1925 by-law, required 7,000 sq. ft. in residence (general and single-family) districts. It was not changed until 1941, when Needham was divided (with respect to lot sizes) into two residential districts. The northeastern portion of the town was zoned for 10,000 sq. ft. lots (80' frontage), while in the southwestern part one acre minimum lots (150' frontage) were required. Since 1941 the basic residential lot requirements have not been altered, although the one-acre minimum area was extended eastward in 1952 and 1954 (see Map III-A, p127). A small 20,000 sq. ft. minimum district (100' frontage) in the northern part of Needham was added in 1954.

While one can imagine much greater contrasts in minimum lot size regulations (both in lot dimensions and patterns) than that between Needham and Lexington, clear differences do exist (both at present and in the past). Moreover, the greater the contrast between zoning laws in this respect, the greater the difference is likely to be between the other characteristics of the communities involved, since minimum lot size regulations

11. Needham's 1941 action resulted in Simon v. Town of Needham (42 North Eastern (2nd) 516), one of the early court cases involving acreage zoning. The town's regulation was upheld in court. The early adoption by Needham of one-acre zoning adds to the interest of studying it here, and in fact was one of the reasons — a not wholly extraneous one — why the town was selected. It is of particular importance in estimating the effects of minimum lot size regulations on gross pattern.
and "character" of a town are probably not independent variables. But this simply indicates the need, noted above, for a larger sample of towns, and therefore of regulations.

With these reasons and reservations, then, Needham and Lexington were selected for study. The predominance of single-family residential structures in the two towns, and the large population expansion since the zoning by-laws were enacted, ensured that many decisions to plat and develop land would have been made under the control of the respective minimum residential lot regulations. The changes in minimum requirements since the 1920's provide an historical framework for analysis of lots platted after passage of the original zoning by-laws and suggest that special attention be paid to certain periods. In the following chapter, the data gathered from the two towns is presented as a series of frequency distributions of lots platted over time, and the characteristics of the distributions are described and analyzed.

12 The choice of minimum lot size requirements as the zoning regulation whose effects would be studied suggested use of towns where pre-zoning development had not been too heavy and considerable open land remained for development. Moreover, since lot-size requirements are most important where low densities prevail, towns with mainly single-family residences were logical choices.
III. Results of the Lot Size Study

1. Data Sources and Problems

The data presented and discussed in this chapter was gathered from the subdivision plat files of the Town Engineering Departments of Needham and Lexington. The various problems encountered in collecting this information—in particular, size and number of subdivisions to be used, placing the date of subdivision, and subsequent lot line changes—are discussed in the Appendix.

It should be pointed out here, however, that the lot size distribution shown in the following charts and graphs is not an exact description of the actual net residential densities existing at present in Needham and Lexington, and should not be taken as such. For one thing, lots platted before the zoning ordinances were adopted in the two towns are not included. Moreover, lot lines were sometimes revised after the original plat was made. And, finally, lots are included which have not yet been developed. Nonetheless, the distributions are probably a good approximation of the lot sizes developed and net residential densities created after the original zoning by-laws, and minimum lot requirements, were adopted in Needham and Lexington.13

2. General Characteristics of the Frequency Distributions

The lot size data summarized in Tables 3-16, pp. 89-107

13. This may be less true in Lexington where many subdivisions platted before the zoning ordinance took effect were not developed for 30 or more years. See p. 41ff.
Eli 241. (pp. 108-123)
and Graphs 1-13 is grouped by chronological periods, corresponding to the intervals during which a particular minimum lot requirement was in effect. In Needham, where the period of a particular minimum requirement was long, the figures are also separated by decades.

There are a number of possible shapes which any frequency distribution of empirical observations may take. It may be rectangular, bell-shaped, U-shaped, J-shaped, i.e., in various ways symmetrical or asymmetrical. One might conjecture, in the study made here, that certain shapes would indicate maximum effect of the lot size regulations, while others would show the reverse. For instance, a rectangular distribution (with all lot sizes occurring at approximately the same frequency) would suggest that the minimum lot requirement was having little influence; and a negatively skewed distribution (with the minimum lot size at the end of the tail, and the most frequent lot size far to the right) would raise doubt as to whether the requirement had any influence at all. Maximum effect would appear to occur if all the lots platted were the minimum specified by law.

In fact, as shown by Graphs 1-13, the distribution of lot sizes under a particular minimum lot requirement all exhibit positive skewness. That is, the most frequent observation (lot size) occurs far to the left, and the remaining observations slope away to the right with a long tail.

14 When two minimum lot sizes exist, and are combined to give a picture of lots platted in the entire town, there are, of course, two marked peaks in the distribution. This does not invalidate the above point, though, since the positive skew still occurs in each zone taken separately.
One of the characteristics of such a distribution is that the mean is largest, the median next largest, and the mode smallest. These relationships exist in virtually all the distributions shown in Graphs 1-13, except where the dominance of the minimum lot size is especially pronounced (and often where the total number of lots is small). As a consequence, although the minimum lot is usually most frequent, the average lot size in a given zone is almost always above the minimum, exceeding it by as much as approximately 11,000 square feet (see Graph 12).

Each zoning change is clearly reflected by the peak frequency of the new minimum lot size in the succeeding period. And the minimum lot size is regularly, with few exceptions, most frequent - both in absolute and proportional terms. In addition, there is sometimes a considerable similarity between different periods in the proportion which the modal frequency is of the total number of lots platted. In Lexington, this is particularly true. Under the 5000, 7500, 12,500 and 15,500 sq. ft. requirements, the minimum lot size is, with a few exceptions, always 22-24% of the total lots platted. (See Tables 3-9). This consistency is not quite so striking in Needham.

Looking at the data another way, one finds that, taking the two towns together, the percentage of lots within 5,000 sq. ft. of the minimum lot size runs from 59% to 95%, with one exception. (See Table 13.) When lots within 10,000 sq. ft. of the minimum are included, the range of the percentages narrows in both towns, to 84-98% (Lexington) and 81-100% (Needham).

15. The differences in this respect, as well as in other matters, will be discussed in the next section of this chapter.
16. The combined distribution of lot sizes in two zones is not included in this comment. See footnote 14.
Once again, though, Lexington shows more consistency between periods than does Needham. In each case, of course, the percentage of lots occurring at any particular dimension varies from period to period, and decade to decade. But the cumulative percentage is a good indication of the degree of central tendency (and the length of the tail) in any distribution, and is a useful tool for comparison of whole distributions, regardless of variation as to modal lot size, etc.

In short, while the legal minimum lot size is normally most frequent in both towns in all periods, the average lot size is still higher than the minimum. At the same time, the number of lots within 5,000 and 10,000 sq. ft. of the minimum never falls below about 60% and 80%, respectively. These distributions will now be analyzed in more detail.

3. Explaining the Deviations: Physical and Legal Factors

Enough has been said thus far to provide a picture of the general characteristics of the frequency distributions of lot sizes platted in Lexington and Needham. Their consistent positive skewness indicates the strong magnetism of the legal minimum. But the long "tail" of each distribution also suggests the influence of other factors. The question which must then be raised is: how can one account for deviations from the minimum requirement? The three most obvious factors which come to mind immediately are physical and legal: shape of the property platted, legal frontage requirements and topography.

Often, for unique, historical reasons, the property to be platted is peculiarly shaped. One result is that, in order to
create sufficient-sized house lots, the new street (when required) may also be peculiarly shaped (e.g., Eliot Rd. in Needham between West and Parish Sts.). Another consequence is that the lots platted may, by necessity, be oddly shaped or unusually deep and thus often larger than the minimum size required.

The shape of property is particularly important when taken in conjunction with frontage requirements. If no such requirements, or very low ones, exist in the legal lot specifications, it may be possible to reduce the effect of oddly formed property by allowing a lot a very small street frontage. Where the frontage requirement does exist, and is not too low, this possibility is eliminated, and the effect of property shape in raising lot sizes above the legal minimum is maximized.

The frontage requirement also may have this effect when taken together with topography. But topographical factors also have an influence all their own. A hilly site may require enlargement of lots above the minimum required in order to provide sufficient space for a house buildable at reasonable cost. Such a site may also affect the location of streets, and thus the size of lots when taken in conjunction with shape of the property. Similarly, low lying land with soggy tendencies may increase lot size to allow creation of a buildable house site, etc.

The skill and intentions of the subdivider are also

17. This factor was particularly noticeable in several parts of Needham (especially the northern part of the town and along the Charles River); and lots were often much larger than the minimum in such areas.
important here. A subdivider sensitive to the contours of land, and skillful at his task, may come up with quite different results from someone lacking such attributes. Subdivision controls, of course, may require a subdivider to heed topography more carefully, thus increasing its effect on lot sizes. And provisions in subdivision controls as to street layout, block length, etc., also put greater constraints on the subdivider. One would suspect that these controls, when taken in conjunction with frontage requirements, shape of property and topography would cause a greater number of deviations from the minimum lot size, though this depends to some extent on the stringency of the controls. The consistency of the lot size distributions from different periods in both Lexington and Needham suggests no sharp change when subdivision controls were introduced, however. In any case, the effects of subdivision controls on subdividing practices on subdividing practices is a study in itself. But one can still suggest that, in general, controls which increase the influence of topography (for example) will tend also to increase the number of deviations above the legal minimum. And those regulations which reduce the influence of the factors mentioned will also tend to reduce the deviations.\[18\]

18. Another possible influence on lot size variations is the tendency of contemporary subdividers to use curved streets and cul-de-sacs in contrast to the earlier emphasis on grid plans. In fact, the larger lots in Needham and Lexington were often on curves, corners, or at the end of cul-de-sacs. The consistency in the frequency distributions from the 1920's to the present in both towns, however, does not necessarily bear this out (insofar as it is evidence).

19. One might expect that "cluster" zoning, for instance, would minimize the influence of the shape of property on lot sizes; and if frontage requirements were also allowed to vary, the effects of that factor would be reduced. One would thus expect greater conformity to the minimum, other things being equal.
These observations, derived from common sense as well as from a general inspection of subdivision plats in Needham and Lexington (where the larger lots were often oddly shaped or on low-lying land), obviously do not provide a systematic, or statistical, relationship between deviations from minimum lot size and shape of property, topography, and frontage requirements. In order to establish such relationships more time would be needed than was available in this study. It should be possible, however, to undertake such a task. For example, lot lines from original plats could be laid out on large-scale topographic sheets; and by counting and measuring, a correlation obtained between lot size, steepness (grade) of lots, amount of lot below a certain elevation (or some measure of degree of swampiness), and any other relevant topographic feature. The exact relationship to frontage requirements might be ascertained by correlating frontage size with lot size; or by making a frequency distribution of frontages and comparing it with distribution of lot sizes as to relative degree of variation or dispersion, and deviation from the minimums.\textsuperscript{20} In both cases it would be important to have a sample size (number of towns) large enough to include quite different topography and frontage requirements.

\textsuperscript{20} Frontage requirements in Needham and Lexington were given on pp.: 20-1. In Needham, there apparently was no frontage minimum from 1925 to 1940, when the 7000 sq. ft. lot was the specified minimum size.

\textsuperscript{21} One advantage of including very flat land, for instance, might be that one could detect more easily the influence of other factors in raising lot sizes above the legal minimum.
4. Social and Economic Factors

While frontage requirements, topography and shape of property are important influences that tend to cause deviations from the legal minimum lot size, it is likely that their effects are mainly confined to creating somewhat random deviations from the minimums. That is, their influence is particularly detectible in the length of the "tail" of a given distribution, i.e., in the appearance of a few lots here and there at a variety of sizes often well above the minimum. This effect is particularly expressed in shifting percentages of lots within 5,000 and 10,000 sq. ft. of the minimum.

Equally important, however, are social and economic forces whose influence is likely to be felt more systematically on the modal lot size itself. Gradual shifts in the modal lot size may be detected in the relative increase in percentage of lots platted at sizes immediately adjacent to the legal minimum, as well as in an actual change in the mode to a size above the minimum. And it is obvious that such upward shifts in the modal lot size indicate the presence of social and economic pressures tending to raise residential lot sizes, even without increases in the legal minimum. While the legal lot specification is in itself the product of social and economic influences operating through the political mechanism of government, it is a fair question whether the residential lot sizes would have risen (i.e., the modal lot size shifted upward) in Lexington and Needham without the existence and assistance of increased legal minimums. In short, what influence, if any, does zoning have on raising the modal lot size?
In attempting to answer this query, one must look at the aggregate frequency distribution of lot sizes—although a town may contain individual subdivisions whose modal lot size is well above the legal minimum. The following sections will therefore examine two types of differences between the lot size distributions in the two towns: 1) differences between periods or decades within each town; and 2) differences between the two towns themselves.

1) Taking Lexington first, where the minimum lot sizes have changed more frequently, one finds that in the first period, 1924-29, under the original 5,000 sq. ft. minimum, the modal lot size was 6-7,000 sq. ft. Such lots occurred twice as often as those at 5,000 sq. ft. (See Table 3.) Moreover, 15% of the lots platted were at 7-8,000 sq. ft., making this size second most frequent. Thus the modal lot size was somewhat above the legal minimum. In 1929, the minimum lot requirement was raised to 7,500 sq. ft.

In succeeding periods in Lexington, one does not find again quite so clear a suggestion that residential lot sizes were rising without assistance from the law; and, in fact, the

22. In Lexington there are two conspicuous examples -- the Five Fields and Six Moon Hill subdivisions approved in 1951-53 and 1947 under the 15,500 and 12,500 sq. ft. minimums respectively. In both cases the distribution of lot sizes was very even and not skewed. In Five Fields the mode was at 33-34,000 sq. ft., and in Six Moon Hill there were two modes - at 21,000 and 23,000 sq. ft. In Five Fields, out of 59 lots (excluding seven for which no size was found), only one was at the minimum lot size, and 22% within 10,000 sq. ft. of the minimum. In Six Moon Hill, there were none, out of 27 lots, at the minimum, none within 5,000 sq. ft. of it, and 29% within 10,000 sq. ft. It is evident that the goals of the subdividers involved were not merely maximization of monetary return; but economic capacities also existed which made such subdivisions feasible.
1929-38 period, for example, 23% of the lots platted were at 7-8,000 sq. ft., with 16% at 9-10,000 and 11% at 8-9,000 sq. ft. (See Table 3.) This reversal of the usual order, however (with the second most frequent lot size larger than the third most frequent), is not common. Moreover, if one divides the period 1929-38 in half, and examines separately the two sections, certain differences appear. (See Table 4.)

During 1929-34, the predominance of the minimum lot (7,500 sq. ft.,) becomes even more pronounced, though with lots at 9-10,000 sq. ft. still in second place. But in the year 1935-38, this predominance fades, the distribution becomes somewhat more even, and the modal lot size rises to 12-13,000 sq. ft. (the new legal minimum adopted in 1938), followed in frequency by lots at 9-10,000 and 13-14,000 sq. ft. In short, while the distribution of lot sizes for the 1929-38 period taken as a whole does not show a marked upward trend in modal lot sizes, such a trend definitely appears in the later years (1935-38).

The techniques of dividing a period into two parts does not yield similar results for 1939-50. (See Tables 6-7.) This is due in large part to the fact that during the first half of the period, 1939-45 (the war years), few lots were platted. Thus the great majority of the lots summarized in the 1939-50 distribution were created in the second half of the period (1946-50), and the distributions for 1939-50 and 1946-50 are very similar. While no evidence exists of a
strong move upward comparable to that in the periods previously discussed, there is a slight shift toward 13-14,000 sq. ft. (the legal minimum being 12,500 sq. ft.). The number of lots occurring at that size is 4% higher than the proportion of those at the legal minimum during 1939-45; the same percentage during 1946-50; and one per cent higher for the whole period (1939-50). To be sure, this is some indication of upward pressure, but it may also be partly a function of the fact that the minimum was 12,500 sq. ft. rather than 12,000.23

The interval during which the 15,500 sq. ft. minimum was in effect throughout all of Lexington (1951-53) was relatively short compared with the preceding periods. (It still controls, of course, in the central portion of the town. See Map III-B.) The main distinction of the 1951-53 distribution is that it has the lowest proportion of lots at the legal minimum of any of the Lexington distributions (except where the mode is above the minimum, of course). (See Table 6.) Moreover, there is little indication during 1951-53 of any significant rise toward the 30,000 sq. ft. minimum established in part of Lexington in 1954.24

Since 1953 in Lexington, there have been no unusual shifts in the distributions, especially not in the 30,000 sq. ft. zone. (See p. 37ff below.) Most recently, though, lot sizes in the 15,500 sq. ft. zone have shown the reversal of order found in

23. Though see the 1954-61 distribution (Table 7) with a 15,500 sq. ft. minimum.

24. The division of both towns into zones with different lot size minimums is discussed more fully in Ch. 4 on gross pattern.
1929-38, with 24% at 15-16,000, 12% at 16-17,000, 18% at 17-18,000 and 14% at 18-19,000. (See Table 9.) Whether this has any significance in portending a rise in the modal lot size only future events can tell.

In Needham, the interval spanned by one lot size requirement is longer than in Lexington; and the data is organized, within each interval, according to decades.

During 1925-40 as a whole, the 7-8,000 sq. ft. lot (the legal minimum) is most frequent. (See Table 10.) Taken by decades, however, one finds distinct differences between the distributions of 1925-29 and 1930-40. In the former period, 45% of the lots platted were at 7-8,000 sq. ft., with 16% at both 8-9,000 and 9-10,000 sq. ft. - a more sharply peaked distribution than for 1925-40 as a whole. During 1930-40, however, the most frequent lot size rose to 8-9,000 sq. ft., followed by lots at 7-8,000 sq. ft. and (thirdly) lots at 10-11,000 sq. ft. Thus, a slight upward trend in the modal lot size is evident during 1930-40, the decade which preceded the 1941 upgrading of the legal minimum lot size to 10,000 sq. ft. No similar trend exists toward one-acre lots, however, also adopted by Needham in 1941.

In the 20 years from 1941 to 1960 in Needham, the legal minimum lot required in the two major zones was in each case the most frequent lot size - 50% of the total in the 10,000 sq. ft.

25. The 20,000 sq. ft. zone established in 1954 is not discussed here since it is very small (See Map III-f), and only one small subdivision (as yet undeveloped) has since been platted in the area. There is in fact rather little undeveloped land remaining in the zone.
ft. zone and 38% in the one-acre zone. (See Table 11.)

Taking the 1941-60 period by decades, one finds that in the one-acre zone there is little to compare, since only about 43 residential lots were platted in that zone during 1941-49, most of them at exactly one acre. The small number of lots platted may account for the greater predominance of the legal minimum size in 1941-49 than in the following decade, 1950-60. (See Tables 13-14.) In any case, no upward trends are noticeable.

In the 10,000 sq. ft. zone, though no upward change in modal lot size is evident, the percentage of lots at 10-11,000 sq. ft. did decline from 61% in 1941-49 to 47% in 1950-60, and the proportion at the next few lot sizes increased slightly. (See Tables 14-15.) The degree of central tendency has remained so strong, however, that it is hard to consider the upward motion other than quite limited.

To summarize - there is some evidence, though not necessarily conclusive - that increases in the minimum lot size requirements have been preceded by an upward shift in the modal size of lots actually platted. This was particularly true in both Lexington and Needham during the 1930's, or portions thereof. In neither town, however, was there any

26. Since the 10,000 sq. ft. zone in Needham has by now been almost fully subdivided, with much of the remaining open land committed to public or other uses, it may be that the percentage drop in lots at 10,000 sq. ft. (but without a shift in the modal lot size) was due more to topographical factors than to general market pressures.

27. A possible external influence toward the end of the 1930's might have been the lot size standards adopted by the Federal Housing Administration. In fact, however, the standards recommended by the FHA in 1935 (6,000 sq. ft., minimum lot size with 50' frontage) were below the legal minimums already
any trend discernible toward one acre or 30,000 sq. ft. lots previous to their adoption as legal minimums in sections of each town. (See Ch. IV.)

These observations are not intended, nor should they be interpreted, as implying any proposition such as: the public decisions to raise legal minimum lot requirements in Lexington and Needham were made because of an actual previous rise in model lot size over the dimensions legally specified. In a given instance, this may or may not have been the case; and no analysis of the actual decisions made on this issue in each town was undertaken in this study. The purpose of the foregoing discussion, rather, was to investigate the general question raised above as to whether the modal residential lot size might have risen in the two towns without the increase in legal minimums. The method used was simply to check the distributions for variations in the modal lot size in periods preceding the actual legal change. With a larger sample of towns, carefully selected as to "character" and the nature of their minimum lot regulations, a more definite answer than that given here might be provided. (See Ch. V.)

adopted in Lexington and Needham at that date. See Subdivisions Development (Circular No. 5), Federal Housing Administration, Jan. 1935 (U.S. Government Printing Office, Washington, D.C.). It may be then that the market catered to in the 1930's, a period of relatively low subdivision activity, was of a somewhat higher economic status (relative to the times) than in periods of massive development schemes. This fact (if true) would definitely tend to raise the modal lot size.

28. These variations are also reflected in the changing proportion of lots within 5,000 or 10,000 sq. ft. of the legal minimum (see Tables 3, 4, 10). But this method of checking a distribution does not necessarily reveal a shift in the modal lot size.
2) Turning now to a comparison of the two towns, one finds a number of clear differences. The most striking one is the generally stronger central tendency of the Needham lot size distributions. In Needham, the proportion of lots within 5,000 sq. ft. of the legal minimum lot size (for each period and zone) rarely falls below 80%, and only once below 70%. The upper limit is 100%, with 90% or over occurring frequently. In Lexington, on the other hand, the percentage of lots within 5,000 sq. ft. of the legal minimum is normally below 80%, and often below 70%. The upper limit is 88%. This difference between the two towns also holds true for the proportion of lots within 10,000 sq. ft. of the minimum.

Similarly, the percentage of lots at the legal minimum size (for each period and zone) almost never goes below 30% in Needham, and rarely rises above 30% in Lexington. (See Tables 3-16.)

A clue to these differences can be found by looking at the main exceptions to the general rule in each town. The distributions which deviate most consistently are those for the one-acre zone in Needham and the 30,000 sq. ft. zone in Lexington. Moreover, the deviations are in opposite directions, so to speak. That is, the frequency distributions for the one-acre zone in Needham are usually less centralized than those in the 10,000 sq. ft. zone, with a lower percentage at the mode, and a lower percentage within 5,000 and 10,000 sq. ft. of the legal minimum. On the other hand, the distributions for the 30,000 sq. ft. zone in Lexington are consistently more centralized than those in the 15,500 sq. ft. zone.
To put it another way, the lot size distribution in Lexington's 30,000 sq. ft. zone and in Needham's 10,000 sq. ft. zone resemble each other more than each does the distribution in the other lot size zone in the same town. And the same appears to be true for the one-acre zone in Needham and the 15,500 sq. ft. zone in Lexington.

In the former case, both the distributions have a higher percentage of lots platted at the legal minimum than is the case in the other lot size zone in each town, and the average lot size is closer to the legal minimum. The distributions are not identical, though, those in Needham having a higher percentage of lots within 5,000 and 10,000 sq. ft. of the required minimum. (See Tables 7,9,11, 13-15.) The proportion of lots at the legal minimum, however, is about the same in both the Needham 10,000 sq. ft. zone and the Lexington 30,000 sq. ft. zone (with variations by decade).

In the latter case (the one acre and 15,500 sq. ft. zones), both distributions show a lesser central tendency, a higher average lot size, and a lower percentage of lots at the legal minimum than does the other zone in each town. Once again, though, the distributions are not identical. A larger percentage of lots in the Needham zone are at the minimum size than is the case in Lexington distributions. The distributions are more similar with respect to proportion of lots within 5,000 and 10,000 sq. ft. of the legal minimum - although the "tail" of the Needham distribution is much longer and the

29. An exception is the 1941-49 period in Needham (See Table 13) when very few lots were platted in the one-acre zone.
cumulative percentages rise more slowly beyond the 10,000 sq. ft. mark than is the case in Lexington.

One observation that may be made on the above is that degree of deviation above the legal minimum lot does not necessarily vary directly with the lot size. The characteristics of the distribution in the Lexington 30,000 sq. ft. zone do not bear out such a suspicion. At the least, it is one instance where the large lot has a more centralized distribution than the smaller.30

In addition, the phenomenon just described becomes more interesting when one observes that following the division of each town into two lot size zones, the majority of lots platted in each instance have been in the zones with the more centralized distributions.31 (See Table 17.) This is especially true in Needham, where an overwhelming majority of the lots counted after 1941 were in the 10,000 sq. ft. zone. The creation of two lot size zones was more recent in Lexington, but the same trend is evident.

Without offering here any explanation for this fact (but see Ch. IV), one can still raise the following questions. Does there tend to be less deviation from the legal minimum lot, regardless of the specified size, in the zone where at a given time, the greatest amount of subdividing is taking place? And is this phenomenon more pronounced when there are two zones in

30. It could be argued that 30,000 sq. ft. is not "large enough" for the effects of size alone to be felt. But in the end, "large enough" can only be defined by the actual characteristics of distributions at different sizes.

31. That is, of course, the majority of lots counted in this study.
a town? To put it another way, when a town has two minimum lot sizes does there tend to be less deviation from the minimum required in at least one zone than when there is a uniform minimum for the whole town — regardless of the rate of subdivision? Or is it just a matter of which part of a town is being most heavily subdivided at a particular moment, regardless of the number of minimum lot size zones?

In Lexington and Needham there is some evidence on both sides of the question. On the one hand, during 1924-29 in Lexington, when the platting rate was fairly high and when one minimum lot size was in effect, the modal lot size was above the 5,000 sq. ft. minimum. (See Table 3.) On the other hand, in Needham from 1925 to 1929, also with one minimum and a high platting rate, the distribution had as strong a central tendency and percentage of lots at the minimum size as distributions in the 1950's in the 10,000 sq. ft. zone — suggesting that the rate of platting rather than the number of zones was more important. (See Table 10.) During the 1930's in both towns, when the number and rate of lots platted fell and only one minimum lot requirement was in effect, the deviations from the minimum were quite marked, except in the early 1930's in Lexington.

This evidence is not conclusive, of course. And it is possible that the critical importance of the rate of subdivision lies in the size of the subdivisions characteristic of a period of rapid development. For larger subdivisions may tend to have both less overall variation in lot sizes and a higher percentage of lots at the legal minimum. If true, this fact would probably be largely due to the financial and economic characteristics of
such large ventures. On the other hand, large subdivisions also occur in periods where development is slower - but there are simply fewer of them. And large subdivisions undertaken at such times may have more variation, less central tendency, etc., than those created during periods of intensive subdivision activity. This throws the burden of explanation back on to the rate of development. But whatever the answer may be, it is obvious that in order to find it a large sample of towns, with different rates of development and with both one and two legal minimum lot sizes would be necessary.

5. Pre-zoning Data

Before summarizing the material and observations made in this chapter, I propose to examine briefly lot size distributions from the pre-zoning period in Lexington. While this information might be regarded as a substitute for data on towns where zoning has not been adopted - it being evidence as to how lot sizes behaved without zoning restrictions - differing economic and social circumstances, as expressed through then contemporary subdivision practices, reduce the validity of comparison with post-zoning distributions. In spite of this reservation (which will be more fully discussed below) it is still useful and relevant to consider this material here.

32. Topography, frontage and shape of property would still be factors tending to produce random variations, of course.

33. The evidence from Lexington and Needham indicates that this was the case in these two towns at least. See also footnote 24.

34. See Appendix, p. 80, on the difficulties of collecting such data for Needham.
The data is organized into three periods: 1921-24 (post-war); 1903-1917; and 1892-98 (with a few from 1872). Perhaps the most striking feature of these distributions is the tremendous rate at which lots were platted, even when compared with the boom period of the 1950's. (See Table 17.) For instance, in the four years (actually 3 1/2, since only the first part of 1924 is included) from 1921 to 1924 over half again as many lots were created as during the whole subsequent era from 1924 (latter half) to 1961. And even more lots were platted from 1892 to 1898. In large part, this was due to the creation of a few, big uniform lot size subdivisions, the most extravagant of which was that called "Meagherville". (See Map IV-B.) This one subdivision accounts for approximately 3,000 of the 3,440 lots counted in the years between 1892 and 1898.36

In any case, the lot size distributions for this era in Lexington all show a very strong central tendency, exceeding that in all post-zoning periods (with the exception of the 30,000 sq. ft. zone, 1954-61). And the modal value is at a much lower lot size, 2-3,000 sq. ft. 37

35. The count made during this pre-zoning period in Lexington is probably not so complete as is the post-zoning data. But the number of subdivisions covered is sufficient to provide a general picture of the distributions.

36. The majority of Meagherville's 2-3,000 sq. ft. lots lie in a swamp, and only a small portion of the subdivision has actually been developed (some quite recently). Many of the lots have been taken for taxes by the Town of Lexington, and various public uses are being considered for the property. The subdivision was bisected by Rt. 128, and the western portion is now zoned for light industry. Another subdivision of some 300 lots (termed "Lexington Estates") also lies in a swamp and has never been developed. It is located just to the north of Meagherville. Both are near the North Lexington railroad station.

37. With "Meagherville" subtracted, though, the distribution changes considerably for 1892-98, with the peak at 5-6,000 sq. ft.
This strong concentration at a very small lot size can be misleading, however, if compared directly with the post-zoning distributions. For the subdivision procedures of the earlier era often differed from those of the present. It was common at that time for the land subdivider to operate separately from the builder. Moreover, it was apparently the practice to purchase two or more of the small, narrow lots in order to create one site for a house (if the purchase wasn't simply speculative). Therefore, the lot size distribution of this pre-zoning era probably reflects much less accurately the residential densities actually developed, since lots were often not platted with the intention or hope that each one have a dwelling structure on it (as is usual when land is subdivided and houses built by the same business operator). This is especially true of the subdivisions with a very large number of very small lots. And in such subdivisions a "lot" is not, practically speaking, the same as a "lot" in the post-zoning years.

Many of the early subdivisions of this type (large number of small lots) in Lexington were in fact clearly premature, and were not developed for 30 years or more. A considerable number of houses in the post-World War II period were erected in these old subdivisions (dating back to 1892) - perhaps explaining in part why fewer lots apparently were platted in Lexington after the war than in Needham, despite Lexington's somewhat faster rate of population growth. Since many of these old,

38. There were also, of course, subdivisions in the Lexington pre-zoning period that were not of this kind, and their development was often less retarded.
undeveloped lots were very small (2-3,000 sq. ft.) with narrow (25-30') frontages, it is probable that the new houses built were on two or more "lots". A most interesting study would be to see just what net densities have actually resulted in these areas, by checking the number of adjacent lots held by one home-owner. Under the present zoning regulations, these densities are not directly controlled, since the lots were legally recorded before zoning was enacted. As such, the actual densities which have occurred might reflect quite purely the social preferences and economic capacity of the home-buyers, and intentions of the builders.

One could, for instance, check for succeeding periods, the actual residential lot sizes which have occurred in these pre-zoning subdivisions as the lots have been gradually combined and developed. The resultant distribution of lot sizes in such subdivisions could be compared with distributions compiled from subdivisions platted during each period but which, by contrast, were controlled by the existing minimum lot size regulations. In effect, this would be one means of investigating the problem raised above as to whether the modal lot size would have risen without an increase in legal minimums. For the lot sizes actually developed as house-sites in the pre-zoning subdivisions are not under the constraint of zoning controls. And yet it is possible that the modal size of lots actually developed in such subdivisions has paralleled

39. This is the case in Lexington and Needham, but it need not necessarily be so. Many legal and political issues are involved in this matter, of course.
the rising legal minimums. The advantage of such a study is that it allows comparisons within one town, rather than between towns (with all the attendant problems of comparability).

While an investigation of this nature would undoubtedly have added a great deal to this thesis there was not, unfortunately, enough time to undertake it. Moreover, the material for carrying it out was readily available in Needham, whereas the study could have been made only with a much greater expenditure of time in Lexington. And yet, paradoxically, the study would have been more fruitful in Lexington than in Needham.

40. There are two reasons for this situation. First, a general property map, showing location of houses, lot sizes, and common ownership of adjoining lots was available in Needham, but not in Lexington. In Lexington, there is a property map drawn up in the late 1930's (and revised), but lot sizes are not given nor is common ownership. Up-to-date property lines and ownership is kept in a card-file, and it would be extremely time-consuming to use such a file, as it would be hard to locate the relevant lots without getting house numbers, owners' names, etc.

Secondly, for some historical reason there do not appear to have been quite so many subdivisions with a large number of very small lots in Needham in the pre-zoning period - that is, of the type of subdivisions whose development was typically arrested. This observation is based on an inspection of a map of existing property lines in Needham, and of some of the older subdivision plats. Existing lot lines may be deceptive, of course, since many lines have undoubtedly been changed. But as far as I could tell, there were only four or so (all from the 1890's) of that type of subdivision in Needham - and mainly smaller, with somewhat larger lots (3-5,000 sq. ft.) than in Lexington. With only one apparent exception, these subdivisions were in the eastern part of Needham, at the Newton border, rather than scattered about the town as in Lexington. The one exception, lying just southwest of the town center lies partly in a swamp, and much of it has been taken for park and school land. In the eastern part of the town, the subdivisions have either disappeared beneath Rt. 128, or the NEIC; or are zoned industrial or commercial; or are only partly developed, with some of the land taken as town park property.

The pre-zoning data which was gathered for Needham - for 1924, the year preceding adoption of the zoning by-law - tends to bear out this apparent difference between the towns. See Table 19, p. 105. The distribution for that year exhibits a modal lot size which was the same as that adopted a year later as the legal minimum and has the same general characteristics of Needham
To summarize - lot size distributions in the pre-zoning period in Lexington, while exhibiting the same skewness of shape found in the post-zoning era (though with an apparent greater degree of central tendency) - cannot be directly compared with the post-zoning distributions. The changes in subdivision and selling practices have altered the nature of a "lot", which formerly was often just a parcel which might be sold with several others, rather than constituting by itself the probable home-site.

But, in spite of this limitation, the investigation of pre-zoning subdivisions in Lexington was useful in suggesting an additional way of estimating the influence of zoning on rising modal lot sizes. In addition, this Lexington data has relevance for the gross pattern of the town, as discussed in the next chapter.

6. Summary

Without recapitulating this chapter in detail, the main points made will be briefly restated here.

The effects of legal minimums on residential lot sizes was shown in both Needham and Lexington by the positive skewness of their lot size distributions, and the successively higher modal lot size following each upgrading of the legal requirements. In neither town, with two main exceptions, Needham post-zoning distributions (though slightly less skewed). In short, then, a study such as that proposed in the text probably would not be so relevant or revealing for Needham, although the data would actually, if it were wanted, be more easily obtained.

41. See Tables 13 and 14.
did the percentage of lots at the legal minimum go much over 60%; and the average lot size was consistently higher than the mode (due to the skewness).

Topography, shape of property and frontage requirements - three legal and physical factors - were viewed as affecting primarily the length and variability of the tail of the distributions; and only secondarily the size of the modal lot or the proportion of lots at that modal value. In other words, it was maintained that significant shifts in the relative percentages of lots platted at the legal minimums, or at sizes immediately adjacent, were more likely due to social and economic pressures operating to increase the modal lot size than to topography, frontage, etc.

With this view in mind, the question was raised as to whether such social and economic factors might have produced a consistent upward trend in modal lot sizes without the assistance of legal minimum requirements. The legal minimums themselves, of course, are the product of social and economic pressures operating through the mechanism of government, rather than solely through the market-place; and the gravitation toward a modal lot size is undoubtedly a result of interaction between preferences expressed through these two basic decisions mechanisms. Nonetheless, it is still a fair question as to whether the modal lot size would have risen, as it has, if the social and economic determinants operated "on their own", so to speak - that is, only through the market-place. 42

42. It is also a question, of course, of the proportion of lots at the mode. The modal lot might have risen without the assistance of legal minimums, but the typical lot size distribution might have been bell-shaped instead of skewed.
From this point of view, then, the lot size distributions in Needham and Lexington were examined for evidence of a rise in the modal lot size prior to the actual zoning change raising the minimum lot requirements. The strongest support for the position that the modal lot size was rising "by itself" was found in both towns during the decade of the 1930's, with some indication of a similar process in Lexington in the late 1920's and perhaps in the 1940's as well. In neither town, however, was there any indication of a real market trend toward the larger of the two lot sizes (30,000 sq. ft. in Lexington; one-acre in Needham). And it may be that these lot sizes would not have become common in either town if the social and economic preferences involved had not had a channel of expression through the mechanism of government, with zoning as an instrument for enforcement.

A further comparison of lot size distributions in the two towns revealed that those in Needham were, on the average, more centralized and had a higher proportion of lots at the modal size, than did the Lexington distributions. A closer examination, however, showed that these differences could be described more accurately as dissimilarity between the distributions exhibited by the two lot size zones in each town.

The Needham 10,000 sq. ft. and Lexington 30,000 sq. ft. zones

43. That, of course, is one of the purposes of government - to give expression to demands not satisfiable through the market process. In any case, the effect of zoning is to consolidate, or jell, the preferences for larger lots. And once the preferences are successfully expressed through the political mechanism, moreover, there may be feedback onto expectations to such an extent that the market begins to produce larger lots even where the legal requirements do not exist.
showed greater resemblance to each other than to the other zone in the same town. And the same was found true for the Needham one-acre and Lexington 15,500 sq. ft. zones.

A possible explanation for this phenomenon was suggested by the fact that in each town the zone with the more centralized, etc., distribution was that in which the rate of subdivision was highest. And, though the Needham-Lexington evidence here was not conclusive, this prompted the reflection that the rate of subdivision may be an economic pressure (reflecting mass social preferences) which tends to increase the usual skewness of lot size distributions under zoning. It was also suggested, among other things, that the presence of two lot size zones, rather than only one, might intensify this tendency.

Finally, a discussion of pre-zoning lot size distributions from Lexington indicated that while such data did not, for various reasons, allow by itself a valid comparison with post-zoning distributions, a study of actual densities resulting in the subsequent development of small lot pre-zoning subdivisions might provide another way of answering the query as to whether modal lot sizes would have risen without increased legal minimums.

In short, then, this chapter presents lot size distributions for Needham which show, in their positive skewness and modal lot size, the effects of legal minimum lot requirements. But closer analysis revealed differences between successive chronological periods, between different lot size zones, and between the two towns. In attempting to explain these differences, proposals were made for further studies which would
allow more refined analysis of the effects of legal minimums on lot size distributions and, thereby, on residential densities.
IV. Analysis of Gross Pattern

The term "gross pattern" is used here to refer to the general "outline" or shape of development, and "the broad pattern of zones occupied by the basic element and density types." This analysis, however, will make only brief reference to the locational pattern of non-residential uses (industrial, commercial, etc.) and will concentrate on the pattern which residential development has taken in Lexington and Needham. Since residential uses predominate in the two towns, it is their arrangement, in any case, which defines the main outline of development. And it is on such uses that residential lot size regulations, the subject of this study as a whole, have their effect.

In the first part of the chapter, the general features of gross pattern in Needham and Lexington, in that order, will be described. This will be followed by a discussion of the relationship between that pattern and minimum lot size regulations in the two towns.

1. Description of the Pattern

a) The most arresting, and, indeed, immediately obvious, feature of Needham's gross pattern is the heavy, compact, concentration of development within the eastern part of the town. Bounded very roughly by Central Ave., Marked Tree Rd., High Rock St., and South St., the outline of this concentration resembles (in two-dimensions) one half of a lemon cut crosswise.

The cut is provided by Rt. 128. (See Map II-A.)

Within the principal settlement are found the main retail commercial centers: Needham Center, at the junction of Highland and Great Plain Ave.; and secondarily, Needham Heights, at West St. and Highland Ave. Both are linear in form. Other small commercial uses (mainly gas stations, food and drug stores, greenhouses) are scattered about the town. But Highland Ave. (and its continuation as Chestnut St.) is the main spine along or near which most commercial activity is located.

At the northern end of Highland Ave., near Rt. 128, heavy commercial and industrial uses fan out in depth on either side, with the largest industrial district (New England Industrial Center) on the far side of the circumferential route. The original industrial area in the town at Needham Heights (see p. 18) - mainly on the western side of Highland Ave., along the railroad tracks and Rosemary Lake - still exists, though some of the old mill structures are now used for other manufacturing purposes. A few industrial uses are located outside these two sections - some along the railroad near Needham Center, and others (all old knitting or textile mills) in the

45. There is, of course, open land on the eastern side of Rt. 128, along the Charles River. Formerly Newton water reservation, it is now held by the Metropolitan District Commission. The position of Rt. 128 cuts it off almost completely from the rest of the town (only one access road exists). And it has had little role in the town's development, though it might be called an eastern green-belt.

46. These two centers, established long before zoning was adopted, have maintained their linear form since. The principal retail area at Needham Center has grown mainly north along Highland Ave., toward Needham Heights and south along Chestnut St. Charles River Village, the other "center" in the western part of Needham, contains now only a gas station and a boat rental establishment.
interior of residential blocks or along the Charles River (in the west).

Within the main settlement, where the majority of residential, commercial, industrial and other uses exist, the only open space are in parks, school land and sites, cemeteries, a golf course, and pockets of undeveloped land (primarily on the fringes along South St. and Central Ave.).

In the less developed part of Needham, while a large extent of the land is in public, semi-public, or institutional uses (town forest, park, school land; US Army missile sites; radio station; Wellesley water land; Babson Institute), at least an equal amount is not so used, and is simply open land. Residential development in this part of Needham consists primarily in large, private, country estates (mainly near the Charles River along South St., Charles River St., and Grove St.); and, more recently, in one-acre house sites (with the largest cluster at or near the Central Ave., Pine St., Charles River St. crossings). On the eastern fringes, and in the northwestern portion the residential densities are higher. There appear to be no significant agricultural uses in the area (unless greenhouses and nurseries are considered as such).

The large amount of undeveloped land in this part of Needham (aside from the often extensive acreages in estates along or near the Charles) is contained in a great rectangle bounded by Grove St., Charles River St., Central Ave., Great Plain Ave. and the Wellesley-Needham line. There are no

47. See below for a discussion of the subdivisions in this area (which was not added to the one-acre zone until 1954).
interior public streets in this area (only small access roads or private ways). Much of the land is marshy (along Fuller-Brook), although several hills with one sharp ridge, also exist.

Topographical features have naturally played a role in the creation of Needham's residential pattern. Residential development early spread in a grid system across the flat land around Needham Center, stopping at the obstacle of Bird's Hill to the east, and channelling to the north along Highland Ave., between the ridge to the west (on which Needham Heights is located) and hilly land to the east. The early subdivisions near the Newton line have been noted already. During the late 1920's and 1930's, Bird's Hill was surmounted, subdivisions pushed generally eastward and southward, and some=strung themselves out along Great Plain Ave., in both directions, while a few appeared near the Wellesley line. (See Map IV-A.)

In the 1940's and 1950's the holdovers in the more developed area were filled in, the eastward push was completed (with Rt. 4b).

48. This grid system at Needham Center is reflected in the basically grid-like pattern of the major streets in the area (which existed prior to subdivision activity). Without too much stretch of the imagination, the parallel streets of Central Ave., Highland Ave., Chestnut St., and Webster St. (in part), with the cross streets of Marked Tree, High Rock, Great Plain Ave., West St., and Webster St. (in part) can be seen as a grid system. Dedham Ave., and Great Plain Ave., are more radial.

49. See footnote 40.

50. Great Plain Ave. was the route of one of the old electric car lines. The other main streetcar route was north along Highland Ave., to Hillside, then to Webster St., Central Ave., and on into Newton. Railroad stations exist at Needham Heights, Needham Center, Needham Jct., Bird's Hill and Charles River Village.
as the boundary); subdividing was active on the southern and western edges of the earlier development (near High Rock St., and Central Ave. and South St.); and in the western and south-western part of the town large-lot residential subdivisions began to appear. Thus, from the original, settled area, development has gradually fanned out fairly solidly, especially to the east and north.

b) Turning to Lexington, a rather different pattern of growth, and consequently existing pattern, is immediately apparent. (See Maps II-B and III-B.) At first, in fact, there hardly seem to be any regularities, with subdivisions scattered here and there. But, if one looks more closely, some consistencies do appear. There is none of the compact, continuous development one finds concentrated on one side of Needham. Instead of a generalized grid, the main streets in Lexington from an axial-radial system, either leading to or passing through Lexington Center. And, also in contrast to Needham, there is a major metropolitan route (other than Rt. 128) passing through the town (bypassing the Center): Rt. 2. Rt. 2A and the old Lowell Turnpike are perhaps comparable to Rt. 135 (Great Plain and Dedham Aves.) in Needham (though the latter

51. The Rt. 128 Study, op. cit., comments: "The subdivision of Lexington has not followed any regular pattern, being dictated by the shape and extent of farm properties bought for development. The resulting street pattern is one of clusters with discontinuities." (p. 105)

52. Worthen, op. cit., says that when Lexington was set off from Cambridge at the end of the 17th century, a church was built in the center of the town where Massachusetts Ave. and the "path" to Watertown crossed. From then on, he maintains, new roads built were "those that brought farmers to the meeting-house", i.e., those that led to Lexington Center.
is less radial in nature. But the two Lexington routes (especially Rt. 2A) seem to have had more effect on patterns of commercial uses. (See Maps II-Bc, II-D.) Little development in Lexington is oriented to Rt. 2, however.

The main commercial center, of course, is at Lexington Center; with a secondary one at the other old settlement, East Lexington, near the Arlington border. But there are also clusters of local retail uses where Marrett Rd. (Rt. 2A), Lowell St., and old Concord Ave. intersect streets leading out from Lexington Center (or coming from another town). No really comparable pattern exists in Needham. Isolated commercial establishments (mainly gas, food, etc.) are found along other main roads. The Raytheon office structure and Itek's converted house, near Rt. 128 and Rt. 2, are probably the newest additions to the outlying commercial uses.

There are few industrial uses in the town, those that exist being mainly on or near the railroad or the Massachusetts Ave.-Bedford St. axis. The new Itek plant in the manufacturing zone in the western Lexington is the most recent use of this type. On the other hand, also in contrast to Needham, numerous greenhouses, nurseries, market gardens, and animal farms are found in Lexington. They are not concentrated in any particular area, however, and are found (large and small) in open areas throughout the town.

On the borders of the town, various large institutional and public uses protrude into Lexington: Arlington water land,

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53. The two centers are further apart than are Needham Center and Needham Heights. And, though linear, Lexington Center is less elongated than its Needham counterpart.

54. See p. 19.
in the area enclosed within Lowell St., Maple St., and the railroad; the Metropolitan State Hospital, County Sanatorium, and Belmont Country Club at the Belmont-Waltham corner; the Cambridge Reservoir at the Waltham-Lincoln corner; and the U.S. Air Force (Bedford Airport) and Lincoln Laboratory (MIT) at the Bedford-Lincoln corner.

The existence of open areas throughout Lexington (referred to above with respect to agricultural uses) is perhaps the most striking contrast with Needham — where most of the open land lies in one large block in the western-southwestern part of the town. Following the axial-radial main street system, the early subdivisions in Lexington (from the 1890's through the 1930's) grouped along these lines at intervals, seeking out the hills and higher land (though not every such site is developed). Thus one finds a string of subdivisions (starting at East Lexington and going out to North Lexington) generally along or near the Massachusetts Ave.-Bedford St. axis, which streets make their way between a series of hills or rises. (See Map IVB).

The location of the subdivisions corresponds to (though was not necessarily caused by) the several railroad stations in Lexington (at East Lexington, Pierce's Bridge, Munroe, Lexington Center and North Lexington). And the main street railway line in Lexington followed that axis.

In addition, there are groups of older subdivisions (also mainly on high sites) at the Marrett Rd.-Waltham St. crossing (Waltham St. also had a street railway line), and between

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55. This excludes, of course, the unsuccessful attempts to create home sites in swamps. See footnote 36.
Massachusetts Ave. and Marrett Rd. in the direction of Lincoln (this part of Massachusetts Ave. had no street railway). But there are also old subdivisions located here and there about the town, often on or near the main streets, but still somewhat isolated.

In the 1940's and 1950's, while there has been some infilling (mainly to the south and west) by subdivisions in the open areas that run in toward the petal-shaped cluster at Lexington Center, a major portion of the subdividing activity has been concentrated in the outer areas of the town, especially in the northeastern part near the Burlington, Woburn and Winchester lines - again with the elevated sites sought after. But this general outward expansion from the older settled areas has not taken place in the more or less continuous fashion found in Needham and a very scattered pattern has been produced. As a result large, pockets of open land (some agriculturally used, some not) remain in Lexington, often penetrating close to the town center.

56. One can make too much of the influence of the street railways. It was probably important along the main Massachusetts Ave.-Bedford St. axis. But towards Woburn along Woburn St., for instance, only one early subdivision of any size is to be found - and most of it was not developed until the 1950's after the street railways had ceased to operate.

57. The actual construction of houses has taken place throughout the town, though, with the development of older, partly-filled subdivisions. See p. 43.

58. It should be emphasized that, unlike Needham, there is not a large, flat area around the town center. Rather, a combination of low land (sometimes marshy) and hills exists. The creation of a neat grid of streets was thus made less likely.
2. Relationship to Lot Size Regulations

The generalized description presented above of gross patterns in Lexington and Needham provides the basis for a discussion of the relationship between these patterns and minimum lot size regulations in each town. At first glance, one is tempted simply to say that in Lexington the legal lot size requirements appear to have had little effect on the gross pattern since subdivisions, though with certain regularities in location, appear throughout the town. Whereas in Needham, the area of concentrated development and the less dense, open part of the town correspond almost exactly to lot size zones which have been in effect for some 20 years (with a few modifications). Lexington, on the other hand, did not adopt patterned lot size regulations (i.e., two or more zones with different minimums) until 1954.

To say this, however, is not to say everything, or enough. It is perhaps profitable as well to examine the conditions which have affected the Needham pattern— and to pose the question of what would have happened in Lexington if it had adopted patterned lot size zoning approximately when Needham did (1941).

The Needham pattern of sharp differentiation between the eastern, developed part of the town, and the western-southwestern open area is a pattern of long-standing, and was well established when one-acre zoning was introduced in 1941. Several important elements have aided the maintenance of this pattern, in particular, the circulation system, topography, and socio-economic factors.

The one State numbered highway which passes through
Needham (besides Rt. 128) does so in a crosswise fashion (almost parallel to Rt. 128), rather than lengthwise (more or less) as do Rt. 2A, Rt. 2, and the old Lowell Turnpike in Lexington. And the other main axis in Needham, Highland Ave.-Chestnut St., drops away to the south, while in Lexington the lengthwise direction of Massachusetts Ave. is picked up and continued in Bedford St. Central Ave., while important in the local circulation system, is no direct link with major outside destinations. This is simply another way of saying that Needham is not on any major metropolitan radial (either new or old) as Lexington has long been. Needham lies below the main Boston-Worcester axis through Wellesley, etc. And this position has undoubtedly influenced the town's overall pattern of development.

Moreover, as pointed out earlier, the great open space contained within the rectangle of Grove St., Charles River St., Central Ave., Great Plain Ave., and the Wellesley Line has few interior roads, so that subdivision in any depth would require the construction of many streets. And in fact the earliest subdivision of any size in the western area took place in one of the most accessible spots: the flat, triangular shaped piece of land between Pine St., Charles River St., and Central Ave. (and the frontage opposite on Pine St.). (See Map IV A.)

The topography in this large bloc was not especially conducive to subdivision, either, much of it being low and swampy (though some high land does exist). The topography in the rest of the western-southwestern part of Needham, while rough in places (and low in some spots along the Charles River) is not on the whole difficult terrain.
But many of the most attractive sites have long been taken up by private residential country estates, whose owners were apparently attracted to Needham by the pleasures of life along the Charles. These estates do not comprise all of the open western area; but the proportion is significant enough so that their presence has very likely been important. Such landowners, often with very large holdings, are not usually under the same type of economic pressure that is evident when a farmer finally decides to give up an unprofitable venture and sell out for subdivision. And it is interesting to note that, although a few of the estates have been platted in the last few years, the earliest subdivisions in the western area were on land formerly used for agricultural or semi-agricultural purposes. In short, the economic characteristics of much of the land-holdings, as well as the social status and purposes of the estate owners, has provided a socio-economic basis for resistance to subdivision in the western part of Needham.

When Needham adopted zoning in 1925, then, there were no subdivisions of any size in the western-southwestern area. During the rest of the 1920's and through the 1930's, the town grew mainly eastward and northward. (See Map IV-A.)

59. This information is taken from land use maps prepared in the late 1930's by the Massachusetts Planning Board. (WPA project: #20677).

60. The little settlement at Charles River Village, though undoubtedly more lively once than now (the large dairy farm there has been abandoned apparently), has never shown much tendency to expand through its own inner dynamics.

Some of the estates may represent the subdivision of much older farms, of course. But this type of subdivision has rather different results for density than the usual activity indicated by the term.
subdivisions did appear to the south, however, pushing toward High Rock St., and South St.; and others occurred out along or near Great Plain Ave. (in both directions). Often (though not always) these plats started at a lot size above the minimum required at the time (7,000 sq. ft.). And at the end of the 1930's one small subdivision (Reddington Road) even had lots up to one acre. In the northwestern area brought under one acre zoning in 1954, the same tendency to plat lots somewhat above the legal minimum was also evident.

In view of this upward trend in lot sizes on the fringes of the western area of Needham, one might ask whether something close to one-acre lots might not have become common in that area even without the 1941 zoning change. But, in fact, only one subdivision (Reddington Rd.) showed any tendency to plat lots that large. And if one looks at the original plan submitted in 1941 by Simon of Simon vs. Town of Needham, one

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61. For instance, Barrett St., platted in 1925, started at 8-9,000 s.f., and 11 of its 24 lots were 11-12,000 s.f. Birchwood Rd., 1921, had one lot at 9-10,000 s.f., 5 at 10-11,000 s.f., and 12 between 13-16,000 s.f. out of 21 (some lot lines changed since). Colonial Rd., 1939, started at 10-11,000 s.f. (4) and ran up to 23-24,000 s.f. (21 lots). Most of the lots in the old subdivision at Lawton Rd. (near Great Plain Ave.) were above the minimum later set. At Parkvale and Emerson Rds., though, the majority were at 7-8,000 s.f. A slightly later subdivision, Robinwood Rd. (1946) also was above average, with 4 lots out of 14 at 19-20,000 s.f., and the lowest at 11-12,000 s.f.

62. The large subdivision, Powderhouse Park (1930-33), on Great Plain Ave. near the Wellesley line, had nearly half of its 87 odd lots at 10,000 s.f., and all but four of the rest were above that size. Clarke Circle (1933-39), started at 12,000 s.f., and its 35 lots ranged from there up to 38,000 s.f. There were some exceptions, too; and in the 1950's the tendency was to stay quite close to the 10,000 s.f. minimum (Rolling Lane, Briarwood Circle, Carol Rd.).

63. See footnote 11.
finds that about half of the 59 lots (reduced thereafter to 23) were at 15-16,000 sq. ft., the largest being 20-21,000 sq. ft. and the smallest 13-14,000 sq. ft. If the western area of Needham had been open to subdivisions of this lot size are appeal to a larger market than that available for one-acre lots (and somewhat more expensive houses 64) might have been feasible.

On the other hand, one might argue that the large estate owners had no intentions of subdividing anyway; and that the rate of development in the western area (which has been fairly slow since the 1941 zoning change) would have been about the same. Thus while the densities of residential subdivisions in the two parts of the town would have been closer together than they are now, the western area might still have remained relatively open, and clearly differentiated at the boundary. 65

This is all speculative, of course. It is at least conceivable that the one-acre zoning may have relieved pressures to develop in the western area, and stabilized a pre-existing pattern. "Relieve" should be read "defer", however, for development (though proceeding slowly) is occurring. Whether the country estates will remain a permanent deterrent, or constitute in effect a transition from farm to urban subdivision remains to be seen. 66

The purpose of this long discussion has been to illuminate 65. The recent purchase by the town of forest, park and school land (as well as other institutional uses in the area) will probably maintain this differentiation, forming a minor green belt.

66. While economic pressures such as those on agriculture may now exist, other factors may also be operative. As the western part of Needham begins to fill up, the "exclusive" character of the area (or some such appeal) may be diluted; and there will be an incentive to move on.
the basis of Needham's main pattern characteristic, and to shed light on the coincidence of the boundaries of that pattern with the principal one-acre zone. If one asks whether patterned lot size zoning in Lexington would have had a similar effect, one must consider the question in the above context.

The differences in circulation system patterns between the two towns have already been described. Suffice to say here that the presence of major metropolitan radials in Lexington (both old and new) has helped to stretch the subdivisions across the town. There are hills (a few of which are dominant), with intervening low areas (some swampy), more or less throughout the town.

Lexington has no Charles River to provide a sharp boundary for the town, or to act as an especially strong magnet for large private residential estates. On the other hand, it has had many large agricultural land holdings; and to date, far more agricultural uses remain in Lexington than in Needham. In any case, whatever the reason, there is no one clearly differentiated part of the town which has long been set off as residential estate country, to the extent evident in Needham.

When one investigates the "peripheral" area of Lexington -

67. I am not considering here any differences in rates of population growth in the two towns as a whole (as distinct from different parts of each town). In fact, as noted in Table 1, and in Ch. II, they have been quite similar. It is possible, though, that Needham's one-acre zoning may have slightly slowed the overall growth recently.

68. Lexington has other attractions, of course. The 1937 WPA land use map for Lexington, however, shows some seven private estates (distinct from various agricultural holdings). On the Needham map from the same period nearly 50 such estates can be found.
taking the line drawn in 1954 between the 15,500 and 30,000 sq.
ft. zones\textsuperscript{69} - an immediate contrast with Needham is apparent.
Even before zoning was adopted by Lexington in 1924, many sub-
divisions had appeared in what is now the 30,000 sq. ft. zone.
(See Maps III-B and IV-B.) Their lot sizes ranged from 2-3,000
sq. ft. (e.g., in part of "Meagherville"; "Colonial Acres" off
Wood St., and Webb St. (off Woburn St.), through the middle
ranges (5,000 sq. ft. and up), with at least one subdivision
having many lots (20 or so) between 30-40,000 sq. ft. (Blossom
Crest Rd. off Waltham St.). Many of these areas, as noted in
Ch. III, were not developed for decades (or never developed).

During the post-zoning period up through the early 1940's,
a few plats were made in this "peripheral" area (at least one
of which, Coolidge Ave. (1926), had lots starting at 9-10,000
sq. ft. (above the minimum). The majority of the subdivisions,
however, took place in what is now the inner, 15,500 sq. ft.
zone.

If in 1941 Lexington had adopted a larger minimum (30,000
sq. ft. or more) in the outer area than in the inner one, a
large number of non-conforming lots would have been created -
in contrast to Needham where most of the lots in the one-acre
zone were well over that amount. These same lots were made
non-conforming in 1954, however. And given a zoning policy of
not requiring changes in conforming lots legally recorded be-
fore adoption of a new minimum lot requirement (or of zoning
itself), the creation of a 30,000 sq. ft. zone had as little

\textsuperscript{69} This may not be the "best" line, but it is convenient and
reflects to some degree differences in amount of open land.
effect on existence of the early plats as it would have had in 1941. In other words, even if a larger minimum lot for the outer area had been added in 1941, its potential effect in creating a sharper pattern differentiation between the two (present) zones would have been minimized by the presence of the older subdivisions.

While thus limited in its possible total effect, the adoption of a 30,000 sq. ft. (or higher) outer zone in 1941 would certainly have affected the sizes of lots platted during 1946-53 in what is now the 30,000 sq. ft. zone. It is relevant to ask, then, what actually were the characteristics of the lots created in that area at that time.

Dividing the subdivisions by location (those now in the 30,000 sq. ft. zone; and those now in the 15,500 zone) and by period (1946-50, under the 12,500 sq. ft. minimum; and 1951-53 under the 15,500 sq. ft. minimum), the lot size distributions show the following. (See Tables 20-21, pp. 106-7).

During 1946-50, when 46% of the lots platted were in the (now) 30,000 sq. ft. zone, the lot size distribution in the outer area was more centralized than that in the inner, with a higher percentage of lots within 5,000 and 10,000 sq. ft. of the legal minimum. Concurrently, the modal lot size in the outer area was at the legal minimum, whereas the inner area had a peak lot size slightly above the 12,500 sq. ft. required. From 1951 to 1953, the situation reversed itself, in a sense. The distribution of lots platted in the inner area showed the

70. In both cases, the distributions differ from the "usual" pattern for Lexington. See Ch. III.
common Lexington pattern - 24% at the minimum lot size; 69% within 5,000 sq. ft. and 83% within 10,000 sq. ft. of the legal minimum. On the other hand, the lot size distribution in what is now the 30,000 sq. ft. zone was unusually even - 14%, 13%, 13% for the first three lot sizes, with an 11% popping up at 21-22,000 sq. ft.

There is, therefore, some evidence to suggest that an upward trend in modal lot sizes was occurring in the outer area during 1951-53, but not during 1946-50. Whether 30,000 sq. ft. lots (or close to that) would eventually have become the modal lot size, one cannot tell. That it would have become as if a minimum lot requirement at that level had been adopted before the war is almost certain.

One may speculate briefly as to what the effect on Lexington's rate of growth would have been if a large lot size zone had been created in the early 1940's. Given the number of lots platted after 1954, under the 30,000 sq. ft. minimum - (60% of the total counted for the town) - it seems unlikely that the rate would have slowed drastically, since strong market demand appears to exist.

It is possible, though, that early adoption of a larger lot zone would have channeled more of the 1946-53 platting into what is now the inner area. The rate of growth would thus not necessarily have been lessened, but the growth itself might

71. The slow development of the one-acre zone in Needham may have been due as much to the unwillingness of estate owners to subdivide as to the size of the lot required. See Ch. III. The Lexington farm land, moreover, appears more vulnerable to economic pressures, and a large lot size might have had little restraining influence in such a situation.
have been more concentrated in one part of the town. Nonetheless, a sharp differentiation between the two zones, such as exists in Needham, would probably not have been possible in any case, given the reasons stated above.

The weakness of any discussion such as this is that one simply cannot be sure what would have happened if...... But it does have value in revealing the pre-conditions - physical, social and economic - for certain minimum lot size zoning policies, and suggesting their possible effects and limitations. In addition, an indication is gained of the types of factors one might wish to hold constant, or deliberately vary, in studying further the relationships investigated here.

3. Summary

To sum up - the existence of a one-acre zone coincident with the boundaries of the differentiated parts of Needham is not necessarily the reason for this sharp distinction. But though the Needham pattern had a well-established previous existence, the one-acre zone may have aided considerably the maintenance of such a pattern, and its role should not be underestimated.

On the other hand, the absence of such a clear differentiation in Lexington cannot be merely accounted for by absence of patterned lot size zoning at an early date; nor would the early adoption of such a policy have produced such a pattern, because of the location of subdivisions in the town prior to any zoning at all.

In a sense, of course, one is simply saying that Needham
is Needham and Lexington is Lexington, each with its own peculiar history, unique physical characteristics, etc. But the temptation to generalize still exists. And one may state, at least as broad hypotheses, that: 1) uniform lot size zoning throughout a town, while it affects the over-all density, is unlikely to have any effects, of its own, on patterns of density; 2) the effects of patterned lot size zoning (two or more zones) in creating sharply defined patterns of density depend on: the period in the town's development when such zoning was adopted; the differential in lot sizes between the zones; and the size of the zones themselves; 3) the influence of such patterned zoning is strongly limited by the physical and economic characteristics of the land involved.

72. For one thing, the development of the old, premature subdivisions already scattered about Lexington, might have been even further stimulated by early adoption of a 30,000 sq. ft. minimum.

73. These generalizations apply particularly to single-family residence zoning. Where a large amount of two-family or multiple-family dwellings exist the pattern differentiations have additional determinants.

74. The 20,000 sq. ft. zone in Needham, for example, has had little influence on town pattern because of its small size and position.

75. It may be that particular physical shapes allow greater differentiation in pattern. Needham's half and half form may be inherently more easy to stabilize by zoning that a center vs. surrounding periphery arrangement.
V. Suggestions for Further Research

The tentative explanations advanced for the data presented in the two preceding chapters can only be tested by sampling more towns. The value, hopefully, of an exploratory study such as this is that it provides some guide for further work.

A few research suggestions have already been made. In this final chapter, ideas for additional investigation of the particular zoning regulation studied in this essay will be developed; proposals for examining the relationship between zoning and another aspect of land use pattern - grain - will be outlined; and, in conclusion, some general reflections will be made on zoning and the study of its "effects".

1. Minimum Lot Regulation Studies

The question posed in Ch. III whether and in what manner modal lot sizes would have risen in the long run without increases in the legal minimum requirement -- could be explored more fully by taking towns which have experienced considerable development since the 1930's, but which have either not raised their minimums or have no lot size regulations. The difficulty here is that such towns may tend to have developed to a considerable size at an early (pre-zoning) date. And, due in part to this fact, their socio-economic character may be such as to attract smaller lot size subdivisions. But so long as there was open land which could be developed during the last two or so decades, thus ruling out the innermost parts of the

76. See p. 29 and p. 41ff.
metropolitan area, this factor could at least be held constant by careful selection of towns. The real difficulty might be finding enough towns that have grown considerably and not raised their minimum lot requirements.

One could also, of course, examine one or more towns which have only very recently adopted zoning regulations, and thus minimum lot requirements. Once again, though, such towns may not be easy to find, and are likely, where they exist, to be on the fringes of the metropolitan area with heavy development just beginning (if they are not completely rural). Such towns, however, would provide data over a long time-span on the behavior of lot sizes without zoning controls.

The problem of locating suitable towns - as well as the difficulties of comparability - could be solved in part by making a study such as that proposed in Ch. III. That is, the actual densities occurring in the development of pre-zoning small lot subdivisions could be examined, and an intra-town comparison made of shifts in modal lot sizes. It might be that, where feasible, this would be a particularly valuable

77. In such areas, where multi-family housing most likely predominates, lot size regulations for single-family houses would not be of much importance anyway, and other aspects of zoning ordinance would be of more interest.

78. Woburn appears to be one candidate, as it apparently has only a general residence district with no lot size regulations (or low minimums). Woburn had a large, early development, with a population of 15,000 in 1910. In various ways it has a somewhat different socio-economic flavor from the towns studied in this essay. It has had, however, a net-in-migration of over 5,000 persons, 1950-60, and a total increase of over 10,000 (see Population Movements in Massachusetts, op. cit.). Boston is not the only metropolitan area which could be studied, of course; and comparisons between different cities in different parts of the country might reveal additional differences in lot size distributions.
type of study and could be used as a check on inter-town comparisons.

If one were more interested in the relationship between lot size regulations and gross patterns of residential development, it would be useful to study more towns which had adopted two or more lot sizes before the post-World War II wave of suburban development, as well as those which did so later in the postwar period. The number of different lot sizes, the size differential between them, the level of the largest minimum, etc., would all be factors, among others, to watch. These towns could be compared with others which, while upgrading their legal minimums, had maintained a uniform lot size for the whole town.

An additional problem to be explored is the relationship between rate of growth and degree of central tendency in the lot size distribution. One might deliberately compare selected towns with different rates of growth to explore this relationship, though there would undoubtedly be problems in holding constant other characteristics (including the lot size regulations themselves).

The problem of comparability of towns selected is bound to be a difficulty whatever the size of the sample taken, but the larger the sample the more one could begin to detect general patterns (if such exist) in lot size distributions. The method of measuring deviations from minimum requirements, while necessary to uncover the actual distribution of lot sizes, is not sufficient in itself to provide an explanation of deviation patterns, as was pointed out in Ch. I, and as was evident throughout this study. Thus, in part, a larger sample of towns would
also allow more reliable correlations between such patterns and underlying social, economic and physical determinants.

But further study of these determinants through a decision-making approach would be necessary in order to reveal details as to how different types of subdividers regard minimum lot regulations, lay out their plats, select land, etc. The decision-making approach, however, would limit one more or less to the present. For study of past decisions one would have to refer to the actual results, i.e., the lot sizes as platted. Decision-making studies would thus be no substitute for sampling many towns and developing correlations between lot size distributions and relevant variables. But they would add another dimension to the analysis, as well as allowing a comparison between stated intentions and objectives (as revealed to questionnaires and interviews) and the actual empirical results of the decisions made.

The "social" effects of minimum lot size regulation are another area for possible research. For instance, the "problem" of social homogeneity in a suburbia dominated by single-family residences has exercised many planners and social critics; and possible social ills resulting from excessive and rigid lot size regulations has attracted some attention. Using some index of social homogeneity or differentiation, one could take towns with a variety of lot size regulations (one uniform size; two or more sizes; large and small, etc.) and attempt to detect any relationship between lot sizes and social homogeneity.

79 One suspects, of course, that the principal social differentiations occur between single-family dwellers (taken as a whole regardless of lot size (within reason), and residents of multi-family structures. Moreover, value of homes may be a more telling index than size of lot. It would be interesting to know, however, if these suspicions were correct.
Similarly, demographic effects, especially rate of growth, might be directly correlated with large lot minimums using a wide variety of towns (and if possible more than one metropolitan area, since overall growth rates differ). Such a study would necessarily have to examine carefully the other factors which influence growth rates.

Doubtless there are many other studies which might be made, and the purpose here was simply to suggest in general terms a number of possibilities. It may be noted in passing that, in a sense, all the minimum specifications in a zoning ordinance or by-law may be regarded as a "model" of development (in those respects) - that is, a picture of what might occur if all the minimums were adhered to in all instances. Deviations indicate the role of factors underlying and affected by the legal requisites, and can be investigated in any case to determine their importance.

2. Zoning and Grain Analysis

Investigation of the relationship between "grain" and zoning is one way in which the physical effects of use regulations in zoning, as distinct from minimum standards, might be determined.

80. One wonders, for instance, if other communities similar to Needham, with one-acre zones of long standing, have continued to grow at the pace that Needham has. Of course, the majority of development has taken place in the 10,000 sq. ft. zone - clear evidence, incidentally, that the maxim stated in Simon vs. Town of Needham (that "A zoning by-law cannot be adopted for the purpose of setting up a barrier against the influx of thrifty and respectable citizens....") has been fulfilled thus far. See also Zoning for Minimum Lot Area, The Communities Research Institute Project, Villanova University (Villanova University School of Law, 1959).
"Grain" - or the extent of "coarse" or "fine" interrelationships between element types and densities - can be described by measurement of distances between a given type or density to the nearest type or density which differs from it (i.e., is so classified). An average distance between types and densities can thus be obtained (as well as a whole frequency distribution).

Any study of the relationship between zoning and grain would have to distinguish the zoning regulations which might affect these distances.

The varieties of adapted space and activity types, and densities of the same, constitute the components of grain - and one could measure distances between four different element types and densities - or fourteen. Thus the number of elements and densities distinguished depends on one's classification system (which could be very broad or very refined). The size of different "use" and density zoning districts and their location with respect to each other is thus of great importance in determining the character of grain, whereas the effects on grain of the number of uses permitted by zoning, or the densities allowed, are relative to one's system of classification.

81. See Lynch and Rodwin, op. cit., p. 205 ff. Lynch has developed the idea of grain and its measurement. There are various techniques of measurement (linear, time, street distance, etc.), and various classifications of types and densities to be distinguished for measurement. It was originally hoped that a study of the relationship between grain and the relevant zoning regulations could be undertaken in this study, and some preliminary measurements were made. But it soon appeared that the time required to make a thorough analysis was not to be had.

82. Where distances are measured between residential dwelling units and other uses, residential density regulations are important, since each unit counts for one measurement.
Policies on non-conforming uses are an important influence on grain, since elimination of such uses would presumably have a "coarsening" effect - though this effect would differ with respect to activities and adapted space. Consider, for instance, a small commercial activity in a housing building-type. If its operation were enjoined, and the structure was returned to family activities, the grain of activities would be affected, but the grain of adapted space would not be.

Special permit provisions affect grain considerably by allowing activities to locate in areas not open to them as a matter of right, thus reducing the effect on grain of separating certain uses into zoning districts.

The general form of a zoning ordinance, moreover, plays an important role in determining grain. One might hypothesize, for instance, that the more exclusive (fewer different activities) were its zoning districts, the coarser the grain of a community would be, other things being equal. A cumulative zoning ordinance or by-law would presumably have progressively less effect on grain as one descends from the "higher" to the "lower" uses. Moreover, zoning obviously does not affect the grain of different activities permitted within a given zoning district (e.g., if greenhouses are allowed in a residential district as a matter of right, the grain of dwelling structures and greenhouses is not influenced by zoning).

All of these regulations, in form or substance, affect grain but do not directly regulate it. Direct regulation would be a specification that activities A and B or building types C and D must be so many feet apart. This kind of provision may
occur in boundary regulations of different use districts, but its effect on overall grain is probably limited.

Having determined the relevant zoning regulations (or chosen one of particular interest), and having selected the classes of building types and/or activities to be considered, one could then follow a number of procedures. For instance, one might compare communities possessing cumulative zoning ordinances with those having exclusive district zoning, looking for differences in the grain of the activities, etc., selected. The same might be done with various special permit and non-conforming use policies or provisions; or with sizes and shapes of zoning districts. In the case of special permit policies, one could, for instance, determine grain both with and without measurements to uses known to be located on a site by special permit, and then compare the results. One could also attempt to separate out the influence of zoning regulations on adapted space and on activities. Compilation of early land use maps and other historical data would allow a comparison of changing grain over time with changes in zoning regulations, map amendments, etc.

In making such studies a knowledge of the factors other than zoning which influence location and number of specified uses within a district (or, to put it another way, which influence the original location and quantity of uses on which the zoning districts were based) would be necessary. For, as always in studying the effects of zoning, one must try to separate out its role from the influence of many other variables.
These suggestions for analysis of the relation between grain and zoning are of necessity presented in general terms. Since little study of grain in general has been done, let alone its relation to zoning, few guidelines exist. Doubtless if one actually undertook such an investigation, the experience itself would generate greater precision of approach and produce additional insights.

3. Concluding Remarks

This thesis has concentrated on the physical effects of zoning in particular the influence of minimum lot regulations on residential lot sizes and gross pattern. Other types of effects may be of equal interest to planners, however. And the focus of one's concern will be determined in part by the type of urban environment with which one is dealing. For instance, in the inner parts of a city standards for apartment house construction and regulations for conversion from single to multi-family residence structures will be of greater relevance than lot sizes for single-family houses. One may be interested in determining, for example, the market requirements for constructing apartments, and deciding whether existing zoning standards are deterring economical operations. Pressures toward higher densities might be detected in illegal conversions to multi-family dwellings and/or in the volume of applications for such conversions, for instance.

The goals of the community are also of considerable

83. See p. 9; and method 4) for studying the effects of zoning.
importance in directing one's interests. If a town wants to encourage new apartment construction, etc., revision of the zoning laws to achieve that objective might have high priority; and knowledge of the effects of the existing regulations in deterring market demand would be valued. But if a town felt the opposite, it would be content with its zoning rules. Thus a "good" ordinance for one town would be a "bad" ordinance for the other, since those adjectives can be applied only with reference to individual or "community" values.

It becomes evident that knowledge of the degree to which given zoning controls satisfy the objectives of a town or city affects the "practical" value of any knowledge of the consequences of zoning regulations. But the difficulty in using a "goal-satisfaction" method for the study of the effect of zoning lies not only in problems of measurement but in the elusiveness of "community objectives". Unanimity is not common among human beings; and internal community disagreements about a zoning change are in reality differences of opinion as to the desirability of the expected consequences of the change.

But the expected consequences are not always those that actually occur. And it is here that the planner, regardless of community goals, and of whether his knowledge will be put to immediate use, has an important role. For greater understanding of the effects of zoning will enable him to illuminate controversies by distinguishing between vague possibilities and reasonable expectations. This thesis is a modest contribution toward that end.
Appendix

In gathering data on lot sizes for this study, three principal problems were encountered. Decisions had to be made on: 1) the size and number of subdivisions to be used; 2) the date at which the subdivision took place; and 3) the importance of subsequent lot line revisions. The subdivision plat files of the Town Engineering Departments of Needham and Lexington were used; and while sufficient to carry out the study, the files were not always organized just as or as completely as one might wish.

1) Size and number of subdivisions used. No sampling technique was used in choosing the number of subdivisions whose lot sizes would be counted. Rather, a complete enumeration was attempted of subdivisions platted following adoption of the original zoning by-laws. As one might expect, however, the records of plats decrease in completeness the further back in time one goes (though this differed between the two towns), although it is unlikely that any significant bias in the data was thereby introduced.

A greater problem existed in the fact that the smaller subdivisions (5 lots or less) were usually not filed in the same manner as the larger ones, especially if they were on existing, rather than new, streets (which they tend to be) and did not require approval under the subdivision control laws. (The requirement of such approval affected to some extent the fashion in which the plats were filed and therefore the ease of locating them.)

The procedure followed then was to go through the main
subdivision plat file (in Needham, a particular set of drawers; in Lexington, a list with a convenient location map), counting the lots and recording the sizes of all the plats found therein, and locating them on a large scale map of the town. Fortunately in both cases the main file was chronologically organized and contained the majority of the subdivisions shown on the town map.

The next step was to spot the subdivisions for which no plat had been found, and, using the card file, organized by streets, attempt to find the plat. In Needham, the assessors' maps were sometimes useful at this point. In the case of the large subdivisions, this method was usually successful, but the smaller ones - especially along existing streets - were elusive. (In particular, the Bird's Hill section of Needham, developed piecemeal apparently in the 1920's and 1930's could not be adequately surveyed (See Map IV-A). After following this procedure as long as time would allow, a point of diminishing returns set in - when the missing plats could not be found or when a map of existing streets at the time the zoning by-law was enacted suggested that the plat was made prior to 1924 or 1925. (In the case of Lexington, though, the completeness of the subdivision records and their good organization allowed a count of lot sizes in all major subdivisions back to the 1890's. See Text. In Needham such a count would have taken a prohibitive amount of time.)

The result of this situation is that smaller subdivisions and subdivisions along streets (both not usually found in the main file) are perhaps not sufficiently represented in the
frequency distributions compiled, though an attempt was made to include as many as possible. For what it is worth, though, I would estimate that their underrepresentation does not alter the main features of the lot size distribution, since they comprise a minority of the lots platted.

2) The date at which the subdivision took place. Precision as to the subdivision date was important since it was necessary to know which lot size requirement was in effect when the plat was made. Otherwise it would be difficult to estimate the effects of the minimum lot regulations. Moreover, some picture of the chronological sequence of subdivision plats within the town was important for the analysis of gross pattern.

In general, the approval date of the Board of Survey or Planning Board (depending on the period) was taken as the subdivision date, although this might not be the date when the plan was legally registered or recorded, or actually developed with dwelling structures. In the more recent plans the date was usually clear, but in the older plats ambiguities sometimes occurred. For instance, in some cases a date of approval could not be found - usually when the plat was not in the main subdivision file. The only plan available might be a registry plan (or land court plan) on which the approval date was not recorded, and the registration date was not always an accurate indicator of when the original plat was made (though developed sites on a plan, or lot sizes below the minimum then required, gave some indication).

Fortunately, extreme ambiguities were not too common, and
were more numerous where small subdivisions, and subdivisions along existing streets were involved. Often the uncertainty simply involved placing a subdivision in one of a certain number of years, all of which were within the control of a particular minimum lot requirement. At the boundary years between changes in lot size minimums it was sometimes not clear whether the plat was made before or after the change, though in general it was evident from the lot sizes themselves. Nonetheless, sometimes, though not frequently, a plat was dated and approved in a particular year, but had lot sizes below the minimum then required. This either meant that it was part of a plat dated from an earlier period (though no plan could be found), or that the lot(s) was not intended to be developed as a house-site. (The zoning regulation says that no dwelling shall be erected on a lot of less than a certain size, not that smaller lots cannot be created at all.) In general, however, the dates are probably correct, though some inaccuracies may exist.

3) The importance of subsequent lot line revisions.

Fairly precise information as to the actual lot sizes was of course essential, since it was differences in square feet of lot which were important. In almost all instances the plats indicated the lot sizes, though on some of the older plans the data was not given (and the lot sizes either had to be estimated, when possible, or omitted from the count).

The decision to count lot sizes on the original plat, rather than at the time when the dwelling structures were actually placed on the land, meant that subsequent revisions of lot lines were not taken into account in the frequency distributions
derived. While the results might no doubt have been interest-
ing, it would have taken an extraordinary amount of time to
trace changes in the size of each lot in the subdivisions
checked. Moreover, such a task would have been extremely dif-
ficult in Lexington where no general property map, or even
assessors' block plans, exist, and data as to existing lot
lines is kept in a card file. In Needham the job would have
been simpler, though still time-consuming, since a large-scale
property map, as well as detailed assessors' block plans, exist.
Since the large-scale property map was used to plot the location
of the various subdivisions, however, it was possible roughly to
perceive the lot line changes which had taken place (though not
by exact number of square feet). Both upward and downward
revisions of lot sizes were found - including lot line changes
as well as the joining of adjacent lots. The effect of these
changes on the actual residential density cannot be accurately
estimated, however, though my impression is that there is an
equilibrium motion toward a mean.

The lot sizes were counted on the original plat since
minimum lot requirements in effect at that time were the control-
ing factor. Both towns have "non-conforming size" clauses
which exempt previously platted and recorded lots from the
requirements of subsequent changes in the minimum lot specifi-
cations. Therefore, a lot legally platted in the 1930's, but
developed in the 1950's, could be used as a house site although
the regulations in effect at the later date required a larger
house-lot.
One result of the decision to count lot sizes on the original plat is that the frequency distribution of lot sizes compiled from the data examined is not an exact description of the actual lot sizes (and actual net residential densities) existing at present in Needham and Lexington. It includes, for one thing, lots not yet developed (especially in the most recent plats). And the distribution excludes, of course, those lots platted before the zoning ordinance was adopted. The frequency distribution is probably, however, a good approximation of the lot sizes developed and not residential densities created since the original zoning date. It should also be remembered though that some of the lots are developed with two-family houses (though most of them are on lots along existing streets, and thus not counted).

Problems similar to those described above are likely to be encountered whenever empirical data is gathered. While they limit the accuracy of the information collected, they do not necessarily destroy it. It is important, however, to adopt clear decision-rules for including or excluding certain data, so as to avoid the introduction of systematic biases.
BIBLIOGRAPHY

Original data, the major part of the thesis, was gathered from the following sources:

1. Land use information:
   a) For Needham, from maps prepared by John Blackwell, consultant planner.
   b) For Lexington, from maps prepared by Samuel P. Snow, Planning Director for the Town of Lexington.
   c) Field checks to supplement the above.
   d) For pre-war data, maps prepared by the Massachusetts State Planning Board as a WPA project during the 1930's.
   e) For land use totals, Greater Boston Economic Study Committee

2. Lot size information:
   From the files of the Town Engineering Depts. in Lexington and Needham.

Additional written material used was as follows:


The Communities Research Institute Project, Villanova University (School of Law), Zoning for Minimum Lot Area, Villanova University (1959).


Massachusetts Dept. of Commerce, Division of Research, Town and City Monographs, Monographs #112 (Lexington), #89 (Needham).


Simon vs. Town of Needham, 42 North Eastern (2nd) 516.

Worthen, A Calendar History of Lexington, 1665-1946.


### TABLE 1

#### Population Changes

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<tr>
<th>Year</th>
<th>Needham Number</th>
<th>% change</th>
<th>Lexington Year</th>
<th>Number</th>
<th>% change</th>
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<tr>
<td>1910</td>
<td>5,026</td>
<td>--</td>
<td>1910</td>
<td>4,918</td>
<td>--</td>
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<tr>
<td>1920</td>
<td>7,012</td>
<td>38%</td>
<td>1920</td>
<td>6,350</td>
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<tr>
<td>1930</td>
<td>10,845</td>
<td>55%</td>
<td>1930</td>
<td>9,467</td>
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<tr>
<td>1940</td>
<td>12,445</td>
<td>15%</td>
<td>1940</td>
<td>13,187</td>
<td>39%</td>
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<tr>
<td>1945</td>
<td>14,507</td>
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<td>1950</td>
<td>16,313</td>
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<td>17,335</td>
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<tr>
<td>1955</td>
<td>21,560</td>
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<td>1955</td>
<td>22,256</td>
<td>--</td>
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<tr>
<td>1960</td>
<td>25,793</td>
<td>58%</td>
<td>1960</td>
<td>27,691</td>
<td>60%</td>
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<tr>
<td>1910-1960</td>
<td>413%</td>
<td></td>
<td>1910-1960</td>
<td>467%</td>
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#### Building Permits Issued - 1946-58

Lexington: 3859 total; average of 297/year, 1946-58.

Needham: 3482 total; average of 268/year, 1946-58.

Source: Town and City Monographs (see above)

#### Income Distribution (1950 U.S. Census)

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<tr>
<th>Income Range</th>
<th>Needham</th>
<th>Lexington</th>
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<tbody>
<tr>
<td>Income under $1,500</td>
<td>13.4%</td>
<td>16.0%</td>
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<tr>
<td>From $1,500 - 2,999</td>
<td>17.6</td>
<td>17.3</td>
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<td>From $3,000 - 4,999</td>
<td>25.7</td>
<td>26.2</td>
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<td>$4,500 and over</td>
<td>43.3</td>
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<tr>
<td>Median Income</td>
<td>$4,195</td>
<td>$3,958</td>
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Source: Town and City Monographs (see above)
TABLE 2

Occupational Distribution

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<th>Group</th>
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<th>Lexington %</th>
<th>Needham No.</th>
<th>Needham %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof., Tech. &amp; Kindred</td>
<td>1077</td>
<td>19.1%</td>
<td>1195</td>
<td>18.6%</td>
</tr>
<tr>
<td>Mgrs., Off. &amp; Prop.</td>
<td>930</td>
<td>16.5%</td>
<td>1193</td>
<td>18.5%</td>
</tr>
<tr>
<td>Clerical, etc.</td>
<td>807</td>
<td>14.3%</td>
<td>918</td>
<td>14.3%</td>
</tr>
<tr>
<td>Sales</td>
<td>584</td>
<td>10.4%</td>
<td>802</td>
<td>12.5%</td>
</tr>
<tr>
<td>Craftsmen, Foreman, etc.</td>
<td>871</td>
<td>15.5%</td>
<td>836</td>
<td>13.0%</td>
</tr>
<tr>
<td>Clerical, etc.</td>
<td>807</td>
<td>14.3%</td>
<td>918</td>
<td>14.3%</td>
</tr>
<tr>
<td>Sales</td>
<td>584</td>
<td>10.4%</td>
<td>802</td>
<td>12.5%</td>
</tr>
<tr>
<td>Craftsmen, Foreman, etc.</td>
<td>871</td>
<td>15.5%</td>
<td>836</td>
<td>13.0%</td>
</tr>
<tr>
<td>Operatives</td>
<td>531</td>
<td>9.4%</td>
<td>781</td>
<td>12.2%</td>
</tr>
<tr>
<td>Pvt. Household Workers</td>
<td>135</td>
<td>2.4%</td>
<td>178</td>
<td>2.8%</td>
</tr>
<tr>
<td>Service wkrs.</td>
<td>370</td>
<td>6.6%</td>
<td>276</td>
<td>4.3%</td>
</tr>
<tr>
<td>Laborers</td>
<td>261</td>
<td>4.6%</td>
<td>234</td>
<td>3.7%</td>
</tr>
<tr>
<td>Not Reported</td>
<td>66</td>
<td>1.2%</td>
<td>32</td>
<td>.1%</td>
</tr>
</tbody>
</table>

Selected Housing Characteristics
(1950 U.S. Census)

<table>
<thead>
<tr>
<th>Type of Structure</th>
<th>Lexington No.</th>
<th>Lexington %</th>
<th>Needham No.</th>
<th>Needham %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 unit detached</td>
<td>3,519</td>
<td>85.8%</td>
<td>3,976</td>
<td>82.5%</td>
</tr>
<tr>
<td>1 unit attached</td>
<td>10</td>
<td>.2%</td>
<td>10</td>
<td>.2%</td>
</tr>
<tr>
<td>1&amp;2 units semi-det.</td>
<td>147</td>
<td>3.6%</td>
<td>184</td>
<td>3.8%</td>
</tr>
<tr>
<td>2 unit structures</td>
<td>322</td>
<td>7.9%</td>
<td>460</td>
<td>9.5%</td>
</tr>
<tr>
<td>3&amp;4 unit structures</td>
<td>96</td>
<td>2.3%</td>
<td>147</td>
<td>3.1%</td>
</tr>
<tr>
<td>5 or more units</td>
<td>9</td>
<td>.2%</td>
<td>41</td>
<td>.9%</td>
</tr>
<tr>
<td>Total</td>
<td>4,103</td>
<td></td>
<td>4,821</td>
<td></td>
</tr>
</tbody>
</table>

Value of One-Dwelling-Unit Structures

<table>
<thead>
<tr>
<th>Less than $3000</th>
<th>Lexington No.</th>
<th>Lexington %</th>
<th>Needham No.</th>
<th>Needham %</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3000-$3999</td>
<td>14</td>
<td>.5%</td>
<td>10</td>
<td>.3%</td>
</tr>
<tr>
<td>$4000-$4999</td>
<td>22</td>
<td>.7%</td>
<td>11</td>
<td>.3%</td>
</tr>
<tr>
<td>$5000-$7499</td>
<td>201</td>
<td>6.5%</td>
<td>142</td>
<td>3.9%</td>
</tr>
<tr>
<td>$7500-$9999</td>
<td>413</td>
<td>13.4%</td>
<td>291</td>
<td>8.1%</td>
</tr>
<tr>
<td>$10,000-$14,999</td>
<td>1443</td>
<td>46.8%</td>
<td>1620</td>
<td>45.1%</td>
</tr>
<tr>
<td>$15,000 &amp; over</td>
<td>969</td>
<td>31.5%</td>
<td>1492</td>
<td>41.5%</td>
</tr>
<tr>
<td>Median Value</td>
<td>$13,025</td>
<td></td>
<td>$13,904</td>
<td></td>
</tr>
</tbody>
</table>

Source: Town and City Monographs (See Table 1)
TABLE 3

Percentage Lot Size Distribution
Lexington: 1924-29 & 1929-1938

<table>
<thead>
<tr>
<th>Lot Size X</th>
<th>2</th>
<th>4</th>
<th>5*</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>-</td>
<td>1</td>
<td>10</td>
<td>21</td>
<td>15</td>
<td>8</td>
<td>6</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>cum. %</td>
<td>1</td>
<td>11</td>
<td>32</td>
<td>47</td>
<td>55</td>
<td>61</td>
<td>69</td>
<td>74</td>
<td>78</td>
<td>81</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21-59</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>cum. %</td>
<td>84</td>
<td>86</td>
<td>88</td>
<td>90</td>
<td>93</td>
<td>95</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21-33</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>cum. %</td>
<td>90</td>
<td>93</td>
<td>94</td>
<td>96</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

x - lot sizes are in thousands of square feet, with intervals from, e.g., 5,000-5,999; 6,000-6,999, etc., except where noted.

* - legal minimum lot size (7500 sq. ft., 1929-38) (5000 sq. ft., 1924-29)

- indicates less than 1%.
TABLE 4

Percentage Lot Size Distribution

Lexington: 1929-34 & 1935-38

<table>
<thead>
<tr>
<th></th>
<th>1929-34 (245 lots)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>lot size</td>
<td>5</td>
<td>6</td>
<td>7*</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>per cent</td>
<td>-</td>
<td>3</td>
<td>33</td>
<td>13</td>
<td>19</td>
<td>11</td>
<td>6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>cum. %</td>
<td>3</td>
<td>36</td>
<td>49</td>
<td>68</td>
<td>79</td>
<td>85</td>
<td>88</td>
<td>91</td>
<td>93</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>15-16</th>
<th>17</th>
<th>18-25</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>cum. %</td>
<td>94</td>
<td>95</td>
<td>100%</td>
</tr>
</tbody>
</table>

<p>| | | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1935-38 (143 lots)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lot size</td>
<td>6</td>
<td>7*</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>per cent</td>
<td>-</td>
<td>7</td>
<td>6</td>
<td>13</td>
<td>8</td>
<td>8</td>
<td>17</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>cum. %</td>
<td>7</td>
<td>13</td>
<td>26</td>
<td>34</td>
<td>42</td>
<td>59</td>
<td>69</td>
<td>78</td>
<td>81</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25-33</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cum. %</td>
<td>89</td>
<td>90</td>
<td>92</td>
<td>94</td>
<td>95</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

x - see Table 3

* - legal minimum lot size (7500 sq. ft.)

- indicates less than 1%. 
### TABLE 5

Percentage Lot Size Distribution

**Lexington: 1939-45 & 1946-50**

#### 1939-45 (87 lots)

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>10</th>
<th>11</th>
<th>12*</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Cent</td>
<td>2</td>
<td>3</td>
<td>19</td>
<td>23</td>
<td>14</td>
<td>13</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Cum. %</td>
<td>2</td>
<td>5</td>
<td>24</td>
<td>47</td>
<td>61</td>
<td>74</td>
<td>80</td>
<td>83</td>
<td>89</td>
<td>90</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25-27</th>
<th>28-31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Cent</td>
<td>5</td>
<td>1</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Cum. %</td>
<td>95</td>
<td>96</td>
<td>98</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 1946-50 (566 lots)

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>12*</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Cent</td>
<td>23</td>
<td>23</td>
<td>10</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Cum. %</td>
<td>23</td>
<td>46</td>
<td>56</td>
<td>61</td>
<td>64</td>
<td>68</td>
<td>71</td>
<td>74</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25</th>
<th>26-29</th>
<th>30-36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Cent</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Cum. %</td>
<td>79</td>
<td>82</td>
<td>84</td>
<td>87</td>
<td>88</td>
<td>89</td>
<td>92</td>
<td>100%</td>
</tr>
</tbody>
</table>

---

**X** – see Table 3

* - legal minimum lot size (12,500 sq. ft.)

- indicates less than 1%.
TABLE 6

Percentage Lot Size Distribution
Lexington: 1939-50 & 1951-53

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>1939-50</th>
<th>1951-53</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(653 lots)</td>
<td>(451 lots)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>1939-50</th>
<th>1951-53</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cum. %</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>per cent</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>1939-50</th>
<th>1951-53</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cum. %</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>per cent</td>
<td>0%</td>
</tr>
</tbody>
</table>

x - see Table 3

* - legal minimum lot size (12,500 sq. ft., 1939-50; 15,500 sq. ft., 1951-53)

- indicates less than 1%. 
TABLE 7

Percentage Lot Size Distribution
Lexington: 1954-61

30,000 sq. ft. zone (626 lots)

<table>
<thead>
<tr>
<th>lot size</th>
<th>30*</th>
<th>31</th>
<th>32</th>
<th>33</th>
<th>34</th>
<th>35</th>
<th>36</th>
<th>37</th>
<th>38</th>
<th>39</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>50</td>
<td>11</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>cum. %</td>
<td>50</td>
<td>61</td>
<td>68</td>
<td>75</td>
<td>81</td>
<td>83</td>
<td>85</td>
<td>86</td>
<td>87</td>
<td>88</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>lot size</th>
<th>40</th>
<th>41</th>
<th>42</th>
<th>43</th>
<th>44</th>
<th>45</th>
<th>46-165</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>cum. %</td>
<td>89</td>
<td>90</td>
<td>91</td>
<td>92</td>
<td>93</td>
<td>94</td>
<td>100%</td>
</tr>
</tbody>
</table>

15,500 sq. ft. zone (411 lots)

<table>
<thead>
<tr>
<th>lot size</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15*</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>23</td>
<td>16</td>
<td>10</td>
<td>9</td>
<td>5</td>
<td>7</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>cum. %</td>
<td>1</td>
<td>24</td>
<td>40</td>
<td>50</td>
<td>59</td>
<td>64</td>
<td>71</td>
<td>75</td>
<td>79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>lot size</th>
<th>23</th>
<th>24</th>
<th>25</th>
<th>26</th>
<th>27</th>
<th>28</th>
<th>29</th>
<th>30</th>
<th>31-72</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>cum. %</td>
<td>83</td>
<td>85</td>
<td>88</td>
<td>89</td>
<td>90</td>
<td>92</td>
<td>93</td>
<td>94</td>
<td>100%</td>
</tr>
</tbody>
</table>

x - See Table 3

* legal minimum lot size

- indicates less than 1%.

Data for 1961 includes only January and February.
### TABLE 8

Percentage Lot Size Distribution

Lexington: 1954-61

<table>
<thead>
<tr>
<th>Lot Size (30,000 and 15,500 sq. ft.) (1037 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lot size</td>
</tr>
<tr>
<td>per cent</td>
</tr>
<tr>
<td>cum. %</td>
</tr>
</tbody>
</table>

| Lot size | 22 | 23 | 24 | 25 | 26-27 | 28-29 | 30* | 31 |
| per cent | 2  | 2  | 1  | 1  | 1     | 1     | 30  | 7  |
| cum. %   | 31 | 33 | 34 | 35 | 36    | 37    | 67  | 74 |

| Lot size | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 40-165 |
| per cent | 5  | 5  | 4  | 1  | 1  | 1  | 1  | 1  | 7      |
| cum. %   | 79 | 84 | 88 | 89 | 90 | 91 | 92 | 93 | 100%   |

---

x - see Table 3

- indicates less than 1%

Data for 1961 includes only January and February.
<table>
<thead>
<tr>
<th>Lot Size Distribution</th>
<th>30,000 sq. ft. zone (107 lots)</th>
<th>15,500 sq. ft. zone (66 lots)</th>
<th>Both Zones (173 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lot Size</strong></td>
<td>30* 31 32 33 34 35 36 37 38 39-41 42-49</td>
<td>15* 16 17 18 19 20 21 22 23 24 25 26-34</td>
<td>26-29 30* 31 32 33 34 35 36 37-49</td>
</tr>
<tr>
<td><strong>Per Cent</strong></td>
<td>63 10 7 4 2 1 4 3 1 5</td>
<td>24 12 18 14 5 11 3 3 2 3 3 2</td>
<td>39 6 4 3 2 - 4 6</td>
</tr>
<tr>
<td><strong>Cum. %</strong></td>
<td>63 73 80 84 86 87 91 94 95 100%</td>
<td>24 36 54 68 73 84 87 90 92 95 98 100%</td>
<td>75 81 85 88 90 94 100%</td>
</tr>
</tbody>
</table>

**x** - see Table 3

*legal minimum lot size

- indicates less than 1%.

Data for 1961 includes only January and February.
TABLE 10

Percentage Lot Size Distribution

Needham: 1925-40, 1925-29 & 1930-40

1925-40 (1463 lots)

<table>
<thead>
<tr>
<th>lot size</th>
<th>5</th>
<th>6</th>
<th>7*</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18-52</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>-</td>
<td>1</td>
<td>28</td>
<td>19</td>
<td>12</td>
<td>12</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>cum. %</td>
<td>1</td>
<td>29</td>
<td>48</td>
<td>60</td>
<td>72</td>
<td>79</td>
<td>84</td>
<td>88</td>
<td>91</td>
<td>93</td>
<td>94</td>
<td>95</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

1925-29 (580 lots)

<table>
<thead>
<tr>
<th>lot size</th>
<th>5</th>
<th>6</th>
<th>7*</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17-32</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>-</td>
<td>2</td>
<td>45</td>
<td>16</td>
<td>16</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>cum. %</td>
<td>2</td>
<td>47</td>
<td>63</td>
<td>79</td>
<td>86</td>
<td>91</td>
<td>94</td>
<td>96</td>
<td>97</td>
<td>98</td>
<td>99</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

1930-40 (883 lots)

<table>
<thead>
<tr>
<th>lot size</th>
<th>5</th>
<th>6</th>
<th>7*</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>-</td>
<td>1</td>
<td>17</td>
<td>21</td>
<td>9</td>
<td>16</td>
<td>9</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>cum. %</td>
<td>1</td>
<td>18</td>
<td>39</td>
<td>48</td>
<td>64</td>
<td>73</td>
<td>80</td>
<td>85</td>
<td>90</td>
<td>93</td>
<td>95</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>lot size</th>
<th>17</th>
<th>18</th>
<th>19-52</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>cum. %</td>
<td>96</td>
<td>97</td>
<td>100%</td>
</tr>
</tbody>
</table>

x - see Table 3

* legal minimum lot size (7,000 sq. ft.)

- indicates less than 1%.
### TABLE 11

Percentage Lot Size Distribution

**Needham: 1941-1960**

<table>
<thead>
<tr>
<th>One acre zone**</th>
<th>(314 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>lot size</strong></td>
<td><strong>per cent</strong></td>
</tr>
<tr>
<td>43</td>
<td>38</td>
</tr>
<tr>
<td>44</td>
<td>19</td>
</tr>
<tr>
<td>45</td>
<td>8</td>
</tr>
<tr>
<td>46</td>
<td>2</td>
</tr>
<tr>
<td>47</td>
<td>2</td>
</tr>
<tr>
<td>48</td>
<td>2</td>
</tr>
<tr>
<td>49</td>
<td>2</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>51</td>
<td>3</td>
</tr>
<tr>
<td>52</td>
<td>2</td>
</tr>
<tr>
<td>53</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>lot size</strong></th>
<th><strong>per cent</strong></th>
<th><strong>cum. %</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>54-55</td>
<td>2</td>
<td>85</td>
</tr>
<tr>
<td>56-58</td>
<td>1</td>
<td>87</td>
</tr>
<tr>
<td>59-60</td>
<td>2</td>
<td>89</td>
</tr>
<tr>
<td>61-63</td>
<td>2</td>
<td>91</td>
</tr>
<tr>
<td>64-67</td>
<td>2</td>
<td>93</td>
</tr>
<tr>
<td>68-72</td>
<td>5</td>
<td>95</td>
</tr>
<tr>
<td>73-348</td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10,000 sq. ft. zone**</th>
<th>(2181 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>lot size</strong></td>
<td><strong>per cent</strong></td>
</tr>
<tr>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>lot size</strong></th>
<th><strong>per cent</strong></th>
<th><strong>cum. %</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>1</td>
<td>96</td>
</tr>
<tr>
<td>20-21</td>
<td>1</td>
<td>97</td>
</tr>
<tr>
<td>22-134</td>
<td>3</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>20,000 sq. ft. zone</th>
<th>(20 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>lot size</strong></td>
<td><strong>per cent</strong></td>
</tr>
<tr>
<td>20</td>
<td>70</td>
</tr>
<tr>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>24-29</td>
<td>5</td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

x - see Table 3  
* legal minimum lot size  
- indicates less than 1%.  
** area covered varies, 1941-60.
TABLE 12

Percentage Lot Size Distribution

Needham: 1941-1960

All Zones (one acre, 10,000 & 20,000 sq. ft.)** (2515 lots)

<table>
<thead>
<tr>
<th>lot size</th>
<th>2</th>
<th>10*</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td></td>
<td>43</td>
<td>14</td>
<td>9</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>cum. %</td>
<td></td>
<td>43</td>
<td>57</td>
<td>66</td>
<td>72</td>
<td>76</td>
<td>79</td>
<td>81</td>
<td>83</td>
<td>84</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>lot size</th>
<th>19</th>
<th>20*</th>
<th>21-22</th>
<th>23-28</th>
<th>29-42</th>
<th>43*</th>
<th>44</th>
<th>45</th>
<th>46-348</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>cum. %</td>
<td></td>
<td>85</td>
<td>86</td>
<td>87</td>
<td>88</td>
<td>93</td>
<td>95</td>
<td>96</td>
<td>100%</td>
</tr>
</tbody>
</table>

x see Table 3
- indicates less than 1%
* legal minimum lot size
** area included in each zone varies, 1941-60.
TABLE 13
Percentage Lot Size Distribution
Needham: 1941-49

<table>
<thead>
<tr>
<th>One acre zone (43 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lot size x</td>
</tr>
<tr>
<td>per cent</td>
</tr>
<tr>
<td>cum. %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10,000 sq. ft. zone (480 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lot size</td>
</tr>
<tr>
<td>per cent</td>
</tr>
<tr>
<td>cum. %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Both zones (523 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lot size</td>
</tr>
<tr>
<td>per cent</td>
</tr>
<tr>
<td>cum. %</td>
</tr>
</tbody>
</table>

x - see Table 3
* legal minimum lot size
- indicates less than 1%.
### TABLE 14

Percentage Lot Size Distribution

Needham: 1950-60

<table>
<thead>
<tr>
<th>One acre zone**</th>
<th>(271 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lot size x</td>
<td>43* 44 45 46 47 48 49 50 51 52</td>
</tr>
<tr>
<td>per cent</td>
<td>30 21 8 2 4 3 2 2 3 3</td>
</tr>
<tr>
<td>cum. %</td>
<td>30 51 59 61 65 68 70 72 75 78</td>
</tr>
</tbody>
</table>

| lot size        | 53-54 55 56 57-58 59 60 61 62 63 |
| per cent        | 3 3 1 1 1 1 - - - |
| cum. %          | 81 84 85 86 87 88 89 |

| lot size        | 64 65-72 73-348 |
| per cent        | 1 3 7 |
| cum. %          | 90 93 100% |

**20,000 sq. ft. zone** (same as Table 11)

<table>
<thead>
<tr>
<th>10,000 sq. ft. zone**</th>
<th>(1701 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lot size</td>
<td>10* 11 12 13 14 15 16 17 18 19</td>
</tr>
<tr>
<td>per cent</td>
<td>47 17 10 8 5 3 2 2 1 1</td>
</tr>
<tr>
<td>cum. %</td>
<td>47 64 74 82 87 90 92 94 95 96</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>lot size</th>
<th>20-21 22-134</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>1 3</td>
</tr>
<tr>
<td>cum. %</td>
<td>97 100%</td>
</tr>
</tbody>
</table>

x - see Table 3

- indicates less than 1%

* legal minimum lot size

** area covered varies, 1950-60
### TABLE 15

Percentage Lot Size Distribution

Needham: 1960

<table>
<thead>
<tr>
<th>Lot Size Zone</th>
<th>42*</th>
<th>44</th>
<th>45</th>
<th>46</th>
<th>47</th>
<th>48</th>
<th>49</th>
<th>50</th>
<th>51</th>
<th>52-54</th>
</tr>
</thead>
<tbody>
<tr>
<td>One acre zone (31 lots)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lot Size</td>
<td>39</td>
<td>17</td>
<td>17</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Cum. %</td>
<td>39</td>
<td>56</td>
<td>73</td>
<td>76</td>
<td>79</td>
<td>82</td>
<td>85</td>
<td>88</td>
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</tr>
<tr>
<td>Lot Size</td>
<td>55</td>
<td>56</td>
<td>57-59</td>
<td>60</td>
<td>61-72</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per Cent</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cum. %</td>
<td>91</td>
<td>94</td>
<td>97</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10,000 sq. ft. zone (95 lots)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lot Size</td>
<td>10*</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Per Cent</td>
<td>47</td>
<td>7</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Cum. %</td>
<td>47</td>
<td>54</td>
<td>58</td>
<td>65</td>
<td>69</td>
<td>73</td>
<td>74</td>
<td>78</td>
<td>82</td>
<td>83</td>
</tr>
<tr>
<td>Lot Size</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29-34</td>
</tr>
<tr>
<td>Per Cent</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Cum. %</td>
<td>84</td>
<td>85</td>
<td>86</td>
<td>88</td>
<td>90</td>
<td>91</td>
<td>92</td>
<td>94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lot Size</td>
<td>35</td>
<td>36-37</td>
<td>38</td>
<td>39-72</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per Cent</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cum. %</td>
<td>95</td>
<td>96</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20,000 sq. ft. zone - none</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

x - see Table 3

- indicates less than 1%

* legal minimum lot size
Table 16
Percentage Lot Size Distribution

Needham: 1960

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>Both Zones (126 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 11 12 13 14 15 16 17 18 19</td>
</tr>
<tr>
<td>per cent</td>
<td>36 5 3 5 3 2 1 3 3 1</td>
</tr>
<tr>
<td>cum. %</td>
<td>36 41 44 49 52 54 55 58 61 62</td>
</tr>
</tbody>
</table>

| Lot Size | 20 21 22 23 24 25 26 27 28 29-34 |
| per cent | 1 1 1 1 1 - 1 1 1 1 |
| cum. %   | 63 64 65 66 67 68 69 70 |

| Lot Size | 35-42 43* 44 45 46 47 48 49 50 51-89 |
| per cent | 3 10 5 4 1 1 - 1 1 4 |
| cum. %   | 73 83 88 92 93 94 95 96 100 |

x - see Table 3
- indicates less than 1%
* legal minimum lot size
**TABLE 17**

**Number of Lots Counted**

<table>
<thead>
<tr>
<th>Year</th>
<th>Louisburg</th>
<th>Needham</th>
</tr>
</thead>
<tbody>
<tr>
<td>1924-29*</td>
<td>744 (5000 s.f.)</td>
<td>1925-29</td>
</tr>
<tr>
<td>1929*-34</td>
<td>245 (7500 s.f.)</td>
<td>1930-40</td>
</tr>
<tr>
<td>1935-38</td>
<td>143 (7500 s.f.)</td>
<td>1941-49</td>
</tr>
<tr>
<td>1939-45</td>
<td>87 (12,500 s.f.)</td>
<td></td>
</tr>
<tr>
<td>1946-50</td>
<td>566 (12,500 s.f.)</td>
<td></td>
</tr>
<tr>
<td>1951-53</td>
<td>451 (15,500 s.f.)</td>
<td>1950-60</td>
</tr>
<tr>
<td>1954-61</td>
<td>1037 (both zones)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>411 (15,500 s.f.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>626 (30,000 s.f.)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3273</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>3978</td>
<td></td>
</tr>
</tbody>
</table>

**Pre-zoning**

<table>
<thead>
<tr>
<th>Year</th>
<th>Louisburg</th>
<th>Needham</th>
</tr>
</thead>
<tbody>
<tr>
<td>1921-24</td>
<td>2039</td>
<td>1924</td>
</tr>
<tr>
<td>1903-17</td>
<td>2634</td>
<td></td>
</tr>
<tr>
<td>1892-98</td>
<td>3440</td>
<td>Total</td>
</tr>
<tr>
<td>1872</td>
<td>277</td>
<td>227</td>
</tr>
<tr>
<td>Total</td>
<td>3517</td>
<td></td>
</tr>
</tbody>
</table>

* Some lots in 1929 platted before the minimum lot size change, some afterward.

Minimum lot size for each period given in parentheses.

These figures are the total number of lots counted in both towns. They do not represent all existing lots in either town, or all lots platted during the period surveyed.
<table>
<thead>
<tr>
<th>Lot Size Distribution</th>
<th>1921-24* (2039 lots)</th>
<th>1903-17 (2634 lots)</th>
<th>1892-98** (3517 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lot Size X</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2 3 4 5 6 7-8 9 10-37</td>
</tr>
<tr>
<td>Percent</td>
<td>1 50 25 1 3 5 2 1 - 1 1 -</td>
<td>1 57 8 4 7 3 2 3 2 1 1 1</td>
<td>2 85 1 1 3 1 1 1 - 5</td>
</tr>
<tr>
<td>Cum. %</td>
<td>1 51 76 77 80 85 87 88 89 90</td>
<td>1 58 66 70 77 80 82 85 87 88 89 90</td>
<td>2 87 88 89 92 93 94 95 100%</td>
</tr>
</tbody>
</table>

x - see Table 3

* some lots were platted in 1924 prior to passage of the zoning by-laws.

** includes 77 lots from 1872.
### TABLE 19
Percentage Lot Size Distribution
Lexington & Needham: Pre-zoning

**Lexington**

1892-98 (minus "Meagherville")

<table>
<thead>
<tr>
<th>lot size&lt;sup&gt;x&lt;/sup&gt;</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>14</td>
<td>-</td>
<td>8</td>
<td>9</td>
<td>16</td>
<td>8</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>cum. %</td>
<td>14</td>
<td>22</td>
<td>31</td>
<td>47</td>
<td>55</td>
<td>60</td>
<td>62</td>
<td>69</td>
<td>73</td>
<td>77</td>
<td>81</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>lot size</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20-37</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>cum. %</td>
<td>83</td>
<td>86</td>
<td>90</td>
<td>92</td>
<td>94</td>
<td>95</td>
<td>96</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Needham**

1924 (227 lots)

<table>
<thead>
<tr>
<th>lot size</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>20</td>
<td>16</td>
<td>16</td>
<td>15</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>cum. %</td>
<td>1</td>
<td>5</td>
<td>14</td>
<td>34</td>
<td>50</td>
<td>66</td>
<td>81</td>
<td>85</td>
<td>87</td>
<td>89</td>
<td>91</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>lot size</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20-64</th>
</tr>
</thead>
<tbody>
<tr>
<td>per cent</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>cum. %</td>
<td>94</td>
<td>95</td>
<td>96</td>
<td>97</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

<sup>x</sup> - see Table 3.

- indicates less than 1%.
TABLE 20
Percentage Lot Size Distribution

Lexington:
Lots Separated by subdivisions now in 30,000 and
15,500 sq. ft. zones

<table>
<thead>
<tr>
<th>Lot Size (sq. ft.)</th>
<th>1946-50</th>
<th>Now in 15,500 Zone (307 lots)</th>
<th>Now in 30,000 Zone (259 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12*</td>
<td>13 14 15 16 17 18 19 20 21</td>
<td>12* 13 14 15 16 17 18 19 20 21</td>
</tr>
<tr>
<td>Per Cent</td>
<td>14</td>
<td>23 8 3 3 4 2 5 4</td>
<td>33 22 12 8 3 5 3 5 3 2</td>
</tr>
<tr>
<td>Cum. %</td>
<td>14</td>
<td>37 45 48 51 54 58 60 65 69</td>
<td>33 55 67 75 78 83 86 91 94 96</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lot Size (sq. ft.)</th>
<th>32 33 24 25-86</th>
<th>22 23 25-31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Cent</td>
<td>1 1 12</td>
<td>1 1</td>
</tr>
<tr>
<td>Cum. %</td>
<td>87 88 100</td>
<td>97 98 100</td>
</tr>
</tbody>
</table>

Total: 566 lots
307 (54%) in 15,500 zone
259 (46%) in 30,000 zone

x - see Table 3
* - legal minimum lot size (12,500 sq. ft.)
TABLE 21
Percentage Lot Size Distribution

Lexington:
Lots Separated by subdivisions now in 30,000 and 15,500 sq. ft. zones

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>1951-53</th>
<th>Now in 15,500 zone (127 lots)</th>
<th>Now in 30,000 s.f. zone (324 lots)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lot Size</strong></td>
<td><strong>Per Cent</strong></td>
<td><strong>Cum. %</strong></td>
<td><strong>Per Cent</strong></td>
</tr>
<tr>
<td>15</td>
<td>24</td>
<td>24</td>
<td>14</td>
</tr>
<tr>
<td>16</td>
<td>19</td>
<td>43</td>
<td>13</td>
</tr>
<tr>
<td>17</td>
<td>6</td>
<td>49</td>
<td>13</td>
</tr>
<tr>
<td>18</td>
<td>11</td>
<td>60</td>
<td>9</td>
</tr>
<tr>
<td>19</td>
<td>2</td>
<td>62</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>7</td>
<td>69</td>
<td>8</td>
</tr>
<tr>
<td>21</td>
<td>3</td>
<td>72</td>
<td>11</td>
</tr>
<tr>
<td>22</td>
<td>3</td>
<td>75</td>
<td>5</td>
</tr>
<tr>
<td>23</td>
<td>3</td>
<td>78</td>
<td>4</td>
</tr>
<tr>
<td>24</td>
<td>2</td>
<td>80</td>
<td>1</td>
</tr>
</tbody>
</table>

Total: 451 lots
127 (28%) in 15,500 zone
324 (72%) in 30,000 zone

x - See Table 3
* legal minimum lot size (15,500 sq. ft.)
LEXINGTON - 1924-29

TOTAL LOTS: 744
RANGE: 3-59,000 sq. ft.
MODE: 6-20,000 sq. ft.
MEAN: 10,500 sq. ft.
MEDIAN: 8-4000 sq. ft.

(LARGEST: 5,000,000 sq. ft.)

NUMBER OF LOTS

SIZE OF LOTS (THOUSANDS OF SQ. FT.)

GRAPH 1
LEXINGTON - 1929-38

TOTAL LOTS: 388
RANGE: 7(5) - 33,000 sq ft
MODE: 7 - 8,000 sq ft
MEAN: 11,000 sq ft
MEDIAN: 9 - 10,000 sq ft

1935-38 (dashed line)
TOTAL LOTS: 143
RANGE: 6 - 33,000 sq ft
MODE: 12 - 13,000 sq ft
MEAN: 13,800 sq ft
MEDIAN: 12 - 13,000 sq ft

1929-34 (continuous line)
TOTAL LOTS: 245
RANGE: 5 - 25,000 sq ft
MODE: 7 - 8,000 sq ft
MEAN: 9,800 sq ft
MEDIAN: 9 - 10,000 sq ft

NUMBER OF LOTS

SIZE OF LOTS

THOUSANDS OF Sq. Ft

GRAPH 2
LEXINGTON - 1939-50

TOTAL LOTS: 653
RANGE: 12,000 - 14,000 sq. ft.
MODE: 13,000 sq. ft.
MEAN: 28,700 sq. ft.
MEDIAN: 14,1500 sq. ft.

1944-50 (CONSUMER BUILDING)
TOTAL LOTS: 864
RANGE: 2 - 14,000 sq. ft.
MODE: 13,000 sq. ft.
MEAN: 21,600 sq. ft.
MEDIAN: 14,1500 sq. ft.

1939-45 (PREWAR BUILDING)
TOTAL LOTS: 87
RANGE: 10 - 28,000 sq. ft.
MODE: 13,000 sq. ft.
MEAN: 15,000 sq. ft.
MEDIAN: 14,1500 sq. ft.

SIZE OF LOTS (THOUSANDS OF 100 SQ. FT.)

GRAPH 3
LEXINGTON - 1951-53

TOTAL LOTS: 451
RANGE: 15-62,000 sq ft
MODE: 15,000 sq ft
MEAN: 21,200
MEDIAN: 18,400 sq ft

NUMBER OF LOTS

SIZE OF LOTS (THOUSANDS OF SQ FT)

GRAPH 4
LEXINGTON - 1954-61
(18,500 square feet)

TOTAL LOTS: 411
RANGE: 1500-72,000 sq. ft.
MODE: 15-16,000 sq. ft.
MEAN: 20,700 sq. ft.
MEDIAN: 18,190 sq. ft.

NUMBER OF LOTS

SIZE OF LOTS
(THOUSANDS OF SQ. FT.)

GRAPH 5a
LEXINGTON - 1954-61

TOTAL LOTS: 626
RANGE: 30-145,000 sq. ft.
MODE: 30-31,000 sq. ft.
MEAN: 33,200 sq. ft.
MEDIAN: 30-31,000 sq. ft.
LEXINGTON - 1960-61

TOTAL LOTS: 107
RANGE: 30-49,000 sq. ft.
MODE: 30-31,000 sq. ft.
MEAN: 31,800 sq. ft.
MEDIAN: 30-31,000 sq. ft.

SIZE OF LOTS

LETHINGTON - 1960-61

TOTAL LOTS: 66
RANGE: 15-34,000 sq. ft.
MODE: 15-16,000 sq. ft.
MEAN: 18,700 sq. ft.
MEDIAN: 17-18,000 sq. ft.

SIZE OF LOTS

GRAPH 6
NEEDHAM - 1925-40

TOTAL LOTS: 1463

RANGE: 7 to 52,000 sq. ft.

MODE: 7,800 sq. ft.

MEAN: 10,800

MEDIAN: 10-11,000 sq. ft.

(CLEAR 960 sq. ft. LEGAL MINIMUM)
NEEDHAM - 1930-40

TOTAL LOTS: 883
RANGE: 700 - 52,000 sq. ft.
MODE: 8 - 9,000 sq. ft.
MEAN: 11,000 sq. ft.
MEDIAN: 10 - 11,000 sq. ft.

(1000 sq. ft. equal minimum)

SIZE OF LOTS
(THOUSANDS OF SQ. FT.)

NUMBER OF LOTS

GRAPH 9
NEEDHAM - 1941-60
(10,000 sq. ft. zone)

TOTAL LOTS: 2,181
RANGE: 1000 - 124,000 sq. ft.
MODE: 10 - 11,000 sq. ft.
MEAN: 12,500 sq. ft.
MEDIAN: 11 - 12,000 sq. ft.

SIZE OF LOTS
(THOUSANDS OF SQ. FT.)

NUMBER OF LOTS

GRAPH 10A
NEEDHAM - 1941-60
(10,000 sq. ft. and)

TOTAL LOTS: 20
RANGE: 20-50,000 sq. ft.
MODE: 20-30,000 sq. ft.
MEAN: 22,500

SIZE OF LOTS
CUMULATIVE OF 10,000

NEEDHAM: 1941-60
(DOE RISE ZONE)

TOTAL LOTS: 314
RANGE: 43-378,000 sq. ft.
MODE: 43-44,000 sq. ft.
MEAN: 52,400 sq. ft.
MEAN: 44-45,000 sq. ft.

SIZE OF LOTS
CUMULATIVE OF 65 FT.
NEEDHAM - 1960

(DUE ACRES 3.000)

TOTAL LOTS: 95
RANGE: 10-89,000 sq. ft.
MODE: 10-14,000 sq. ft.
MEAN: 14,000 sq. ft.
MEDIAN: 12-13,000 sq. ft.

NUMBER OF LOTS

SIZE OF LOTS

(THOUSANDS OF SQ. FT.)

0 10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

NEEDHAM - 1960

(DUE ACRES 3.000)

TOTAL LOTS: 31
RANGE: 43-72,000 sq. ft.
MODE: 43-44,000 sq. ft.
MEAN: 44,000 sq. ft.
MEDIAN: 44-45,000

NUMBER OF LOTS

SIZE OF LOTS

(THOUSANDS OF SQ. FT.)

0 10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

GRAPH 13
LOCATION of NEEDHAM and LEXINGTON in BOSTON METROPOLITAN AREA
MAP OF THE TOWN OF LEXINGTON
MASSACHUSETTS
1958
As Amended to December 31, 1961

NOTE: Frontage and area requirements in R1 districts differ depending on whether or not lots are within or without the area enclosed by a broken line.
ZONING MAP
OF THE
TOWN OF
NEEDHAM
MASS.

LEGEND

SINGLE RESIDENCE
GENERAL RESIDENCE
INSTITUTIONAL
BUSINESS
MANUFACTURING

SCALE

A - 1 ACRE - 150' FRONTAGE
B - 10000 SQ. FT. - 80' FRONTAGE
C - 20000 SQ. FT. - 100' FRONTAGE

MARCH 1943
MAY 1945
DEC. 1947
OCT. 1955
DEC. 1956
SEPT. 1948
DEC. 1951
SEPT. 1949
DEC. 1950
APR. 1957
JULY 1958
DEC. 1952
JUNE 1954
ENGINEER
PUBLIC WORKS DEPT.
FRANK L. CHENEY

MAH. MARTIN, TOWN
ENGINEER
ZONING MAP OF THE TOWN OF LEXINGTON, MASSACHUSETTS
1958

As Amended to December 14, 1958

NOTE: Frontage and area requirements in R1 districts differ depending on whether or not lots are within or without the area enclosed by a broken line.

LOCATION OF SUBDIVISIONS

R1 R2 R3 C1 C2 C3 M1 T1

MAP II-B
p. 130