THE OTTAWA CENTRAL AREA: THE APPLICATION OF PRINCIPLE COMPONENTS ANALYSIS TO THE STUDY OF AN URBAN LANDSCAPE

BY

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CHAPTER I

INTRODUCTION

1.1. Problem Definition

This study proposes to analyse the structural organization of the Ottawa Central Business District through the application of a model developed by Philippe Pinchemel. The application of this model will permit a definition of the latent dimensions which underlie the visible landscape and which simultaneously order its structure and function. The analysis does not necessarily focus on the problem of CBD delimitation but more specifically on its definition and spatial organization within the study area.

1.2. The Study Area

1.2.1. The Problem of Central Area Delimitation

Two studies concerning central area development Etude de la zone centrale d'Ottawa and Downtown Demand Study propose different boundaries for the Ottawa Central Area. Both studies however differentiate between two major zones within this central area: the central core, or the Central Business District as defined by Murphy and Vance,[1] and a

[1]Three pioneering articles dealing with the delimitation of the CBD were published by Murphy and Vance during the mid-fifties: R.E. Murphy and J.E. Vance Jr. "Delimiting the CBD," Economic Geography, XXX (1954), 189-221; R.E. Murphy and J.E. Vance Jr., "A

peripheral zone characterized essentially by residential land use. The central core may designate the main business section of the city (Upper Town) or include the Rideau Street retail area (Lower Town). The definition and the boundaries for the central area therefore vary according to the agency undertaking research within the area, or according to the specific purpose of a study necessitating a Central Business District delimitation.

1.2.2. Boundaries of the Study Area

The proposed detailed analysis necessitates that the extent of the study area be limited to two census tracts. To the East of the Rideau Canal, census tract 54 (1971 census tract identification) is bounded to the North by Guigues street, to the East by Cumberland, to the South by Daly and to the West by the Rideau Canal. Census tract 48 is bounded to the North by the Ottawa River, to the East by the Rideau Canal, to the South by Gloucester street and to the West by Bronson avenue and Commissionner. The block bounded by Guigues, Parent, St. Patrick and Sussex streets belongs to census tract 55 but was added to the study area for the sake of contiguity. The choice of this statistical limit was first conditioned by the necessity of obtaining demographic and socioeconomic data from Statistics Canada. However, the "random-rounding" technique incorporated by Statistics Canada for all

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Comparative Study of Nine Central Business Districts," Economic Geography, XXX (1954), 301-36; R.E. Murphy, J.E. Vance Jr. and B.J. Epstein, "Internal Structure of the CBD," Economic Geography, XXXI (1955) 21-46.

1971 census material has rendered such data, even at the "enumeration area" level, totally useless. Percentage error counts on a block basis can add up to more than 50 percent. The study area nevertheless coincides rather closely to local authorities' conception of the Ottawa Central Area. The size of the area is also of adequate proportion to permit the distinction of internal distinctive zones.

1.2.3. The Spatial Unit within the Study Area

The unit of observation which permits a detailed analysis of the urban landscape is that of the block area. This regular fragmentation of urban space constitutes a statistically significant unit of observation since it reveals a unique aspect of the humanisation of space. This uniqueness does not reside in that the block shape is prescribed by the grid system of land allotment, a common pattern in North American Central Business Districts; it is found rather in the intrinsic power of this form to order the present structure and organization of the urban landscape.

Several variables must be surveyed at the property level. This information is then aggregated on a block basis. The block can therefore be defined as one or several properties bounded by streets or roadways, accommodating either pedestrian or vehicular traffic. When this definition cannot be strictly applied, the boundary of the block coincides with that of the property. Some consideration was given to the study of block faces as units of observation. A portion of the information is lost, however, as corner lots or corner buildings must be realistically identified with only one block face. Where some buildings

indicate business addresses on two streets, either front and rear, or, as is most often the case, on a street corner, their allocation to one block face becomes an arbitrary choice. The information matrix thus includes a total of 82 observation units indicated on map 1.

1.2.4. Choice and Availability of Data

The theoretical background which dictates the choice of variables is provided to a large extent by the work of Murphy and Vance. The general framework of the study, however, is adopted from Philippe Pinchemel.[1]

Most of the data incorporated in this analysis was obtained from the Ottawa municipal offices. City assessment records provided data on land ownership and land value. Detailed studies carried out by the municipality within the central area provided land use information for both 1961 and 1971, as well as building stock data for 1971. As previously indicated, due to the random-rounding technique adopted by Statistics Canada, census information was limited to population data for both 1961 and 1971. A complete list of variables and variable descriptions is found in appendix A.

1.3. Analytical Technique: Component Analysis

The analytical technique used in this study is that of factor analysis or more specifically principal component analysis initially

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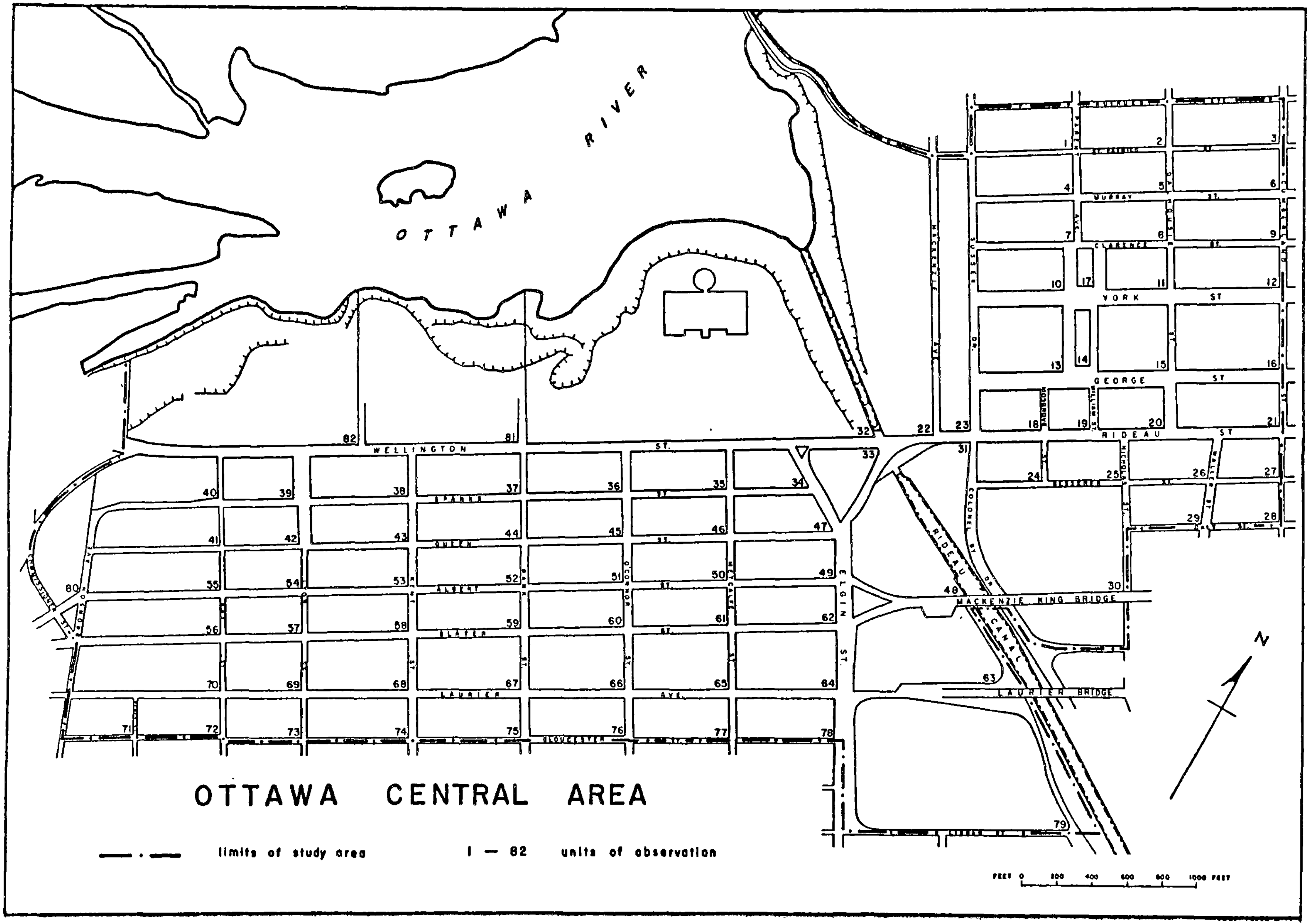
[1] A thorough discussion pertaining to the choice of data and the general framework of the study is found in Chapter II.


OTTAWA RIVER
WELLINGTON ST.
SPARKS ST.
QUEEN ST.
ALBERT ST.
SLATER ST.
LAURIER AVE.
GLOUCESTER
ELGIN ST.
RIDEAU CANAL
MACKENZIE KING BRIDGE
LAURIER BRIDGE
RIDEAU ST
GEORGE ST
YORK ST
CLARENCE ST.
MURRAY ST.
SUSSEX DR.
MACKENZIE AV.
N
OTTAWA CENTRAL AREA
limits of study area
1 — 82 units of observation
FEET 0 200 400 600 800 1000 FEET

MAP I

developed by Pearson (1901) and Hotelling (1933). "Factor analysis is a method of studying simultaneously the complex interrelationships between many variables...as measured for many different observations...and summarizing the important relationships in the form of a few basic patterns called factors." (Murdie, 1969). One of the principal objectives of factor analysis is therefore to attain a parsimonious description of observed data. In this study, principal component analysis is used for exploratory purposes at two levels. Firstly it allows the possibility of reducing data in order to retain only those variables essential to the definition of basic structural components;[1] secondly it permits the detection of relationships and patterns which may lead to the formulation of hypotheses. Principal component analysis involves the following steps.[2]

1. Each analysis begins with a data matrix M with measurements for n observations on m variables. As King points out: "The assumption that we are dealing with multivariate normal distributions is not essential for the principal component solution unless certain inferential questions are posed." (King, 1969). Consequently the data has not been log transformed and linearity must be assumed.

2. The data matrix is replaced by a standard score matrix Z, transforming the original data into standard scores for each of the n

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[1] It must be understood that the definition of a 'basic structure' is only relevant in terms of the chosen variables for each analysis.

[2] The steps indicated are taken from Robert Murdie, Factorial Ecology of Metropolitan Toronto, 1951-1961, Department of Geography Research Paper No. 116 (Chicago: Univ. of Chicago, 1969).

observations on the m variables. Since component analysis is dependent on the total variance of the original variables it has become customary to express the variables in standard form: "Otherwise, by change of units or other linear transformations of the variables, the ellipsoids could be squeezed or stretched so that their axes (the principal components) would have no special meaning." (Harman, 1967). The data is therefore reduced to common units of one standard deviation around a mean of zero.[1]

3. From the standard score matrix, a correlation matrix R (m x m) calculates the simple correlation coefficients between each variable and every other variable. In component analysis the principal diagonal of the correlation matrix contains the correlation of a variable with itself, the sum of which indicates the amount of variance analyzed. The correlation matrix is reproduced for each analysis but includes only those values from $\pm$.30.

4. The object of principal component analysis is to transform the correlation matrix R into an m x p factor loading matrix A. Since the number of factors equals the number of variables, p = m, the principal axes technique orders the factors found in terms of the amount of variance they define:

> "An important feature of the new components is that they account, in turn, for a maximum amount of variance of the variables. More specifically, the first principal component is that linear

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[1] Anderson also proposes this transformation: "principal component analysis is most useful when the variates x_i are all measured in the same units." T.W. Anderson, Introduction to Multivariate Statistical Analysis (New York: John Wiley & Sons, Inc. 1958), p. 279.

> combination of the original variables which contributes a maximum to their total variance; the second principal component, uncorrelated with the first, contributes a maximum to the residual variance; and so on until the total variance is analyzed. The sum of the variances of all n principal components is equal to the sum of the variances of the original variables." (Harman, 1967).

The factor loadings are correlation coefficients between variables and factors and may theoretically take on values between +1.0 and -1.0. Essentially, only factor loadings from $\pm$.40 are retained for the definition of a factor. The eigenvalues indicate the proportion of the total variance in the original data accounted for by each factor. The program used in this study extracts only those factors with an eigenvalue of at least 1.0 which is most often considered the critical value for the retention of factors. The percent of total variance for a factor is:

$$V^t = \frac{\sum \alpha^2}{m} \times 100$$

where $\sum \alpha^2$ = sum of squared factor loadings for a factor

m = number of variables (in principal components analysis $m = p$)

This figure shows the percent of total variance among the variables related to a particular factor and serves therefore to measure its strength. The communality, which can be obtained by summing the squared loadings for a variable, is the proportion of a variable's total variance which is accounted for by the factors; This value indicates the role of a variable within the total factor structure. All these values are reproduced for each analysis; for the purpose of clarity, only loadings of $\pm$ .30 are retained in the tables.

5. The unrotated factors may be unique to a given data matrix since the factor loadings for each variable is dependent on all the variables included in the analysis; however, an infinite number of rotated solutions is possible. This poses problems in terms of factor

definition and also in the interpretation of factor scores, since several variables may have high loadings on a number of factors. The purpose of rotation is therefore to insure that factors identify distinct clusters of variables whereby each variable is identified with one or a small portion of factors, and the number of variables correlated with a factor is minimized. These characteristics correspond to what Thurstone called simple structure. In this study, the factors were rotated according to the normal varimax solution. The most interesting feature of this solution is its invariance property: "Invariant factors will delineate the same cluster of variables as long as some variables defining the cluster are included in the analysis, regardless of the inclusion or exclusion of variables unrelated to the cluster" (Rummel, 1970). This property of the varimax solution has been proven by Kaiser and is stated by Thurstone as "a fundamental requirement of a successful factorial method" (Thurstone, 1947). The values of the factor loadings in the rotated matrix A' will differ from the unrotated matrix A, as will the eigenvalues for each factor or compoment; the total explained variance, however, remains constant.

6. The factor score matrix S can be computed from either the rotated or non-rotated factor loading matrices in combination with the standard score matrix Z to yield an n x p matrix. These factor scores measure the strength of any given factor for each observation. Since these weights are standardized, threshold values for the cartography of factor scores were chosen from $\pm.50$ and ±1.0.

1.4. Objectives of the Study

The objectives of this study may be formulated as follows:

1. To determine the significant factors and therefore the basic structural patterns which characterize the visible urban landscape by means of principal component analysis.
2. To evaluate the use of such a statistical procedure in generating hypotheses concerning these structural patterns.
3. To analyse some of the changes which have occurred between 1961 and 1971 in order to discern evolutionary trends.
4. To compare the resulting statistical landscape, as formulated by the use of principal component analysis, with the observed visible landscape.

CHAPTER II

CONCEPTUAL FRAMEWORK

2.1. The Central Business Index Technique

Two main streams of discussion have evolved in the geographical literature concerning CBDs. The first deals with the problem of the CBD delimitation, the second, with the problematic approach to the study of CBDs.

2.1.1. Early Attempts at Delimiting the CBD

Several studies were undertaken where the extent of the study area was assumed, or local agencies' definition accepted. A first example of this type of delimitation is found in a study written by the sociologist Earl Johnson in 1941. In this historical analysis of the Chicago CBD he notes that the accepted boundaries "constitute by commonly accepted definition the central business district of the city." (Johnson, 1941). In an article written in 1950, George Hartman compares several CBDs as a basis for generalizations regarding CBD shape and writes "the basic portions of this report are the result of an examination of existing land use maps and related studies." (Hartman, 1950). A third example of this type of delimitation is found in John Rannells, The Core of the City where he identifies a "standard block ... which has been used for years by the city as a convenient map unit for recording data." (Rannells, 1956). The basic argument is that

although these methods of outlining CBDs seem adequate for the purposes of these studies, they would not, or should not serve to compare one CBD with another for the purpose of arriving at generalizations. The proponents of this argument are Raymond Murphy and J. Vance who indicate that some standardized and reasonably objective delimitation technique is needed in order to outline comparable areas:

> "... no uniform method of delimiting the district has been used, ... for each city the limits of the CBD have been largely a matter of local agreement. This is all very well for a planner in an individual city, working on local problems, but it is only through the use of a standardized method of delimitation that significant comparisons of CBDs are possible. And it is only through such comparisons that a real knowledge of the content and functioning of this critical area can be attained."[1]

CBD studies which preceeded Murphy and Vance's Central Business Index technique focused mainly on the commercial function within that area. William-Olsson, in analysing the central shopping district of Stockholm devised a delimitation index based on retail trade.[2] Defining retail trade as trade not only in goods but also in meals, amusements and lodgings he used the term "shop rent index" which he defined as the total of shop rents of a building divided by the length of the frontage of the building. A similar index was devised by two Norwegian geographers, using trade data instead of shop rent data, which produced

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[1] R.E. Murphy and J.E. Vance Jr., "Delimiting the CBD," op. cit. p. 189. An extensive review of CBD literature is given in this article. A more up to date bibliography focusing on recent attempts in applying the Central Business Index Technique is given in R.E. Murphy, The Central Business District, (Chicago: Aldine, 1972).

[2] W. William-Olsson, "Stockholm: Its Structure and Development," Geographical Review, XXX (1940), 420-38.

similar results.[1] Volume of retail trade was also used in a U.S. Census Bureau study supervised by Malcolm Proudfoot. "Block-frontage-volume-of-sales" was used in order to identify intra-city commercial areas.[2]

These studies clearly identify commercial intensity as one central function and further indicate some effort at functional area delimitation.[3] The data used, however, is difficult if not impossible to obtain in North American cities and, as in Proudfoot's case, represent an enormous amount of data manipulation.

2.1.2. The Central Business Index Technique

The Central Business Index or C.B.I. method of CBD delimitation, devised in 1954, is also known as the Murphy and Vance technique. This technique requires an a priori distinction between central business uses and other land uses which are judged non-central in character. Table I clarifies this distinction. The hypothesis on which this land use distinction is based proposes that the really essential central business activities appear to be the retailing of goods and services, and the performing of various financial and office functions for the city as a

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[1] T. Sund and F. Isachsen, Bosteder og arbeidosteder i Oslo (Oslo: Oslo Kommune, 1942).

[2] Malcolm J. Proudfoot, "City Retail Structure," Economic Geography, XIII (1937), 424-28.

[3] Two studies should be noted which deal with population movement within the CBD thus identifying another aspect of central density. Gerald W. Breese, The Daytime Population of the Central Business District of Chicago, (Chicago: University of Chicago Press, 1949), and Donald L. Foley, "The Daily Movements of Population into Central Business Districts," American Sociological Review, XVII (1952), 538-543.

TABLE I

LAND OCCUPANCE CONSIDERED NON-CENTRAL

BUSINESS IN CHARACTER

1. Permanent residences (including apartment buildings)
2. Transient residence (hotels and other transient lodgings)
3. Government and public property (including parks and public schools, establishments carrying out city, county, state and government functions)
4. Organizational establishments (churches, fraternal orders, colleges, etc.)
5. Industrial establishments (except newspapers)
6. Wholesaling with stocks and commercial storage
7. Vacant buildings or empty stores
8. Vacant lots
9. Railroad tracks and switching yards

Source: R.E. Murphy, The Central Business District (Chicago: Aldine, 1972), pp. 26 and 185.

whole and for its region. In view of the changing character of the CBDs, however, one might argue that the exclusion of the modern hotel with its large convention halls, its array of sub-terranean or street level boutiques, is outdated. These hotels and other complex developments which mix office, commercial and residential use are part of that movement, encouraged by most municipalities and downtown developers, towards the maintenance (or creation, as the case may be) of a people place within the downtown core. Through such developments, several municipalities tenaciously endeavour to injest a new vitality within the downtown core which has long suffered from the rivalry of suburban development, and thus gain a certain control over the dispersion of urban activities.

The application of the delimitation technique requires land-use

mapping of a large area gravitating around the peak land value intersection (PLVI) and involves the calculation of two critical ratios for each of these blocks. The first of these, the Central Business Height Index (CBHI) is obtained by dividing the total floor area of central business uses in a block, by the total ground floor area. The second ratio, the Central Business Intensity Index (CBII) is the percentage of the total floor space in a block devoted to central business use. Both indexes are used in tracing the extent of the CBD.

A number of significant variables are outlined in this delimitation technique: floor space, building height, lot coverage. In turn, these variables depend on an a priori definition of land use, the integrating variable. Realistically, an a priori definition of central business uses cannot satisfactorily reflect the changing character of CBDs. The purpose of the technique is to determine a boundary (a thorny geographical question) and it was not devised as an instrument by which characteristic components of the area may be discovered.

2.2. Problematic Discussions Regarding CBD Analysis

Discussions inquiring into the problematic and methodological approach to the study of central areas recur frequently in geographical literature. In 1956, Rannells suggests the necessity for establishing a factual basis for analysing phenomena of growth and change within the CBD "with the goals of conserving or enhancing urban resources." (Rannells, 1956). Pernelle also emphasizes the necessity of achieving dynamic results to the extent that operational definitions of analytical

components may facilitate developmental policies.[1]

It is generally argued that a number of variables isolated by Murphy and Vance should be incorporated within an analysis of the CBD though not specifically in the context of its delimitation. Paul Cornière summarizes this point of view by suggesting that city centre definition must be based on the analysis of the centre's components and that this analysis in turn may be distinct from a formal delimitation of the centre.[2] Since there are no fixed limits to city centres, their delimitation remains an abstract notion locked in a given temporal framework. Such essays therefore support the validity of the Murphy and Vance technique while proposing other theoretical considerations.

2.3. The CBD and its Relationship to Urban Structure

The early theories of city structure, most especially that of Burgess and Hoyt, accentuate the importance of the CBD as a centralizing force to which other functional areas can be related.[3] Harris and Ullman, in the development of the multiple nuclei concept, recognize the

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[1] Jacques Pernelle, "Une méthodologie d'étude du centre-ville," Urbanisme, No 117 (1970), pp. 45-47.

[2] Paul Cornière, "Studies on Town Centers in France" in Urban Core and Inner City, Proceedings of the International Study Week, September, 1966 (Leiden: E.J. Brill, 1967), pp. 4-21.

[3] Ernest W. Burgess, "Growth of the City," in R.E. Park, E.W. Burgess and R.D. McKenzie (eds.), The City (Chicago: University of Chicago Press, 1925) pp. 113-38; Homer Hoyt, The Structure and Growth of Residential Neighborhoods in American Cities (Washington D.C.: Federal Housing Administration, 1939).

role other nuclei may have played in the growth of cities.[1] In a restatement of the multiple nuclei theory, Ullman indicates that the central business district is losing its uniqueness but that it may remain one of many functional centres in a city.[2] John Alpass hypothesizes a total scaling down of the hierarchial centre structure:

> "The traditional centre will give way to a system of different networks for the different businesses and institutions located around the region. The separate urban activities may create their own hierarchy, but these internal hierarchies will not necessarily lead to hierarchial centre structure."[3]

Planning aimed at preserving the traditional hierarchial structure would therefore be ineffective, leaving the development of the region to assemble around dispersed or decentralized units, forming a casually scattered structure.

Gutkind more emphatically advocates the death of the central area. He believes that the uncontrolled use of the automobile is intrinsically related to urban sprawl and the disintegration of the central area, no longer accessible to its urban population. The concept of the central area would therefore disappear, for its uniting bonds, once rooted in the religious and political, the social and economic aspects of human existence, have been reduced, in past decades, to "purely materialistic

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[1] C.D. Harris, and E.L. Ullman, "The Nature of Cities," Annals of the American Academy of Political and Social Sciences, 242 (1945), 7-17.

[2] Edward L. Ullman, "Presidential Address: The Nature of Cities Reconsidered," The Regional Science Association, Papers and Proceedings, IX (1962), 7-32.

[3] John Allpass, "Changes in the Structure of Urban Centers," Journal of the American Institute of Planners, XXIV (1968), 171.

instruments of an acquisitive and affluent society, and their symbolic essence has evaporated into a fall-out of financial transactions" (Gutkind, 1962).

At first glance, the argument may appear to stem from different definitions of central area or CBD. A partial definition of the CBD as proposed by Murphy and Vance seems to support Gutkind's statement:

> "Absence of the normal profit motive excludes from the characteristic CBD list municipal and other governmental buildings and parks, churches and other religious establishments and land, public and other non-profit making schools, organizational establishments such as the quarters of fraternal orders and several other types of space occupance. The establishments included in this group perform necessary functions, and they add to the crowding, and hence to the problems of the CBD. But it is the intention of the writers that they are not the central businesses that give the area its essential character." (R. E. Murphy and J. E. Vance, 1954a)

They also write, "the CBD is the heart of the city... It is... an area of superlatives, the very quintessence of urbanism, symbolic of the city and of city life" (R. E. Murphy and J. E. Vance, 1954a). This latter and more eloquent definition is reminiscent of Labasse's statement: "Pour le géographe, le centre est en définitive le lieu ou le foyer de convergence où la ville exerce et affirme sa puissance et d'où se dégage une image qui en exalte le rayonnement" (Labasse, 1970). The area under consideration is therefore the same, although its operational definition, most often elucidated for the purpose of establishing a boundary,may vary. This, however, may be an understatement of the central area definition problem in as much as differences in cultural perception of the central area are oversimplified or ignored. As Berry points out the "relativist" objections to comparison within factorial ecology, one may also indicate similar difficulties which may arise in area definition where the historical and cultural contexts play a significant role.(B.J.L. Berry, 1971)

Central place theory also offers a framework within which to view the dominance and locational primacy of the CBD.[1] Several authors contend that, in modern cities, centrality is no longer identified with the central area or CBD. Labasse argues that if this distinction between central area and centrality is necessary, it is because the value of the central area is constantly confused with its function. "A functional ensemble of building stock perfectly adapted to the purpose for which they were built, well-endowed with the most advanced technical apparatus and further enjoying an efficient transportation network, would probably constitute an excellent business district; but it will not qualify as a central area for it lacks in such important amenities as beauty, pleasure, and atmosphere which create social linkages and the impression of belonging" (Labasse, 1970).

It is perhaps the concept of centrality which should be questioned. Bowden distinguishes between relative centrality, as defined by Christaller, and absolute centrality: "Absolute centrality is the amount of central functions necessary to serve the complimentary region and the central place itself; i.e., the population and activities both inside and outside the central place." (Bowden, 1971). Following this distinction he considers as central business district forming uses, the entire group of central functions that make up the central business district and contribute to its existence and growth as a central place. He concludes that "any wholesaler and manufacturer localized more than

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[1] M.J. Proudfoot, op. cit.; H. Carol, "The Hierarchy of Central Functions within the City," Annals of the Association of American Geographers, L (1960), 419-38; B.J.L. Berry, Geography of Market Centers and Retail Distribution, Foundations of Geography Series (Englewood Cliffs, N.J.: Prentice Hall, 1967).

by the pull of centrality than by any other factor (or sum of factors) is a potential central business use or CBD-forming establishment." (Bowden, 1971). This principle may be taken as the basis for identifying central district uses of all types — retail, wholesale, government, cultural, manufacturing — at any point in time, for any city.

Although the present study cannot consider the full historical evolution of the Ottawa CBD, this principle may be applied in order to establish which activities can be characterized as CBD-forming at the present time, and which activities are likely to be characterized as CBD-forming in the future. All land use types which occur in the study area are therefore considered in the analysis.

2.4. A Stratigraphic Approach to the study of Urban Landscapes: the Pinchemel Model

Philippe Pinchemel's model proposes the study of urban landscapes through the juxtaposition of three stuctural patterns involving land ownership, land organization, and land use (Pinchemel, 1968). Land ownership is a basic element of the urban landscape from which proceeds many decisions concerning the use of a parcel of land. The organizational pattern is meant to understand the combination of infrastructural elements and the fragmentation of land which can be observed in areal photographs. Land use is concerned with the economic use of the land.

Building stock can be included within the organizational pattern. The inclusion of building stock or structural stock, as defined by Larry Bourne, provides an insight into the organizational characteristics within each block and adds a tri-dimentional element to land use. Bourne proposes two uses for the term structure. The first usage is that "of

urban spatial structure, which refers to the framework, arrangements, and interrelationships among urban phenomena as they are distributed in space." (Bourne, 1967). In the second and more limited usage, "structures or stuctural stock are used interchangeably with buildings or building stock."(Bourne, 1967).

The model further proposes that the above structural patterns, which account for most of the observed spatial differentiation, be studied following three approaches: morphological, structural and dynamic.[1] Although ill-defined within the initial conceptual framework these approaches lend themselves, for the purpose of the current analysis, to the following methodological interpretation. The morphological analysis is the study of forms and their spatial distribution. The structural analysis is the relationships which exist between the structural patterns in terms of their operational definition. The dynamic analysis incorporates the temporal aspect into the study, as forms and their relationships are dynamic elements which change through time.

The Pinchemel model should therefore be viewed as a conceptual stratigraphic approach to the study of urban landscapes. The visible landscape does not result from a juxtaposition of heterogeneous elements, but stems rather from the complex organization of these elements. The isolation of each structural pattern can only be provisional, a

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[1]One of these approaches in P. Pinchemel's article is termed 'stratigraphic.' Following discussions with Professors P. Pinchemel and J.-B. Racine, the structural analysis was incorporated within the general framework and the term 'statigraphic'reserved for the study of a series of elements or structures which together define the visible landscape. S. Rimbert also interprets 'stratigraphic'to mean the juxtaposition of the three previously defined structural patterns: Les paysages urbains (Paris: Armand Colin, 1973), p. 138.

starting point for analysis.

2.5. Organization

The study focuses especially on the evaluation and interpretation of a statistcal landscape formulated by principal components analysis. Chapter three provides an historical perspective into the elements of site and situation which determined the founding of the city and therefore the present site of the central area; the initial land surveys on the other hand, determined the internal morphology which dictates the formal organization. Pursuant to the Pinchemel approach, the first study undertaken is that of land ownership (chapter four), since ownership decides, to some extent, the availability of investment capital which, in turn, may affect the use of a specific parcel of land. The more tangible determinants of land use are of course, demand, the quality of existing building stock, relative location, and zoning constraints. In this first analysis, attention is devoted to both the nonrotated and rotated matrices in order to evaluate the strengths and weaknesses of each matrix. Chapter five examines building stock and land use characteristics; this analysis is undertaken for both 1961 and 1971 in order to discern evolutionary trends. For each analysis some attempt is made to critically evaluate the statistical results in terms of the visible landscape. This critical evaluation leads to the reduction of the data matrix, so that only pertinent variables may be retained. Chapter six therefore involves the comprehensive analysis of variables considered statistically relevant for the definition of the Ottawa central area.

CHAPTER III

OTTAWA: AN HISTORICAL PERSPECTIVE

3.1. The Role of History in Shaping the Central Area

3.1.1. Historical Elements of Site and Situation

The city of Ottawa is located at the foot of the Chaudière Falls on the South shore of the Ottawa River where two major tributaries flow into the Ottawa: the Gatineau River from the North, the Rideau River from the South. Although the construction of the Rideau Canal is undoubtedly responsible for the founding of Ottawa, the combined elements of site and situation guaranteed the eventual colonization and development of the area.

The limestone ridge crossing the Ottawa River imposed a point of portage for explorers who followed this important water-route toward the western interior of the continent. The importance of this location, in terms of relative position between Upper and Lower Canada and in terms of potential settlement, was recognized as early as 1791. On August 5th of that year a parliamentary committee recommended the establishment of a town "at the junction of the forks of the River Reddo..." (Brault, 1946). The fork was formed by a branch of the Rideau which divided into two parts at Dow's Lake, one draining into the Ottawa above the Chaudière Falls, the other flowing towards Nicholas Street into the Rideau River. Excellent stretches of farmland suitable for grain crops and dairying

awaited to be cleared. The Gatineau tapped a vast portion of this forest wealth and offered important potential in terms of water power. "In its virgin state almost half of the entire Ottawa watershed was forested with white and red pine." (Eggleston, 1961). The historical importance of the Rideau River belongs to the Rideau Canal era which added the decisive element of urban growth during the Bytown boom years.

The first settlers to reach the area, led by Philemon Wright, settled on the North shore of the Ottawa in 1800. After the war of 1812-1815 free grants of land were offered on the Rideau River to the men of the 99th and 100th Regiments. The first families who were to create the town of Richmond arrived from Quebec at the foot of the portage on the south side of the Chaudière Falls in 1818. In order to service the new settlers, a warf was built on that site in 1819 which later became known as Richmond Landing.

As early as 1790, plans were submitted to the British Government for the construction of a military canal between Lake Ontario and the Ottawa River; "but the troubled state of Europe, the inability of England to undertake the work, and the poverty of the colony forbade the beginning of so great an enterprise." (Ross, 1927). The War of 1812-1815 clearly demonstrated the advantage of having interior communication between Montreal and Kingston, away from the vulnerable border along the St. Lawrence. This military decision created a town which would probably have developed at a later date, giving Wright's Village or Hull the initial advantage of an early start. More specifically, the choice of the site, locating the entrance of the canal from the Ottawa River, is responsible for the present location and pattern of the Ottawa

central area.

The original lot surveys and the core of the city could have focussed within the area known as LeBreton Flats, West of Nepean Bay, the more serious of two alternatives proposed for the entrance of the canal in addition to the present site. Seriously considering the strategic and commercial potential of the Chaudière Falls portage, the Earl of Dalhousie had expressed his wish in 1820 to obtain the property known as Richmond Landing. "From the Richmond Landing place, ...I think it desirable to obtain that lot of the landing place, as a Government depot of stores whether for emigrants at present, or for warlike stores hereafter."[1] The land in question was lot #40 from the foot to the head of the Chaudière Falls and along Nepean Bay and further bounded by Bronson, Carling Avenues and Booth Street. Captain John LeBreton having undoubtedly heard of the Governor's intentions bought the land for £499 from the original grantee, Robert Randall, and attempted to resell to the Government for £3,000. The Earl of Dalhousie refused to partake in such land speculation.

In order to avoid further land speculation at the expense of the government, the Earl of Dalhousie endeavoured to purchase another property before news of the canal scheme became public. In 1823 he bought from Hugh Fraser the property bounded by the Ottawa River and Cathcart street, the Rideau River, Rideau and Wellington streets and

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[1] Letter to Lieutenant-Governor Peregrine Maitland, dated at Sorel, September 22, 1820, cited by Lucien Brault, Ottawa Old and New (Ottawa: Ottawa Historical Information Institute, 1946), p. 56.

Bronson Avenue for the sum of £750.

> "Had I waited for the necessary reference to England, there is every reason to apprehend that the same advantage might have been taken of Government as was attempted by the proprietor of Richmond Landing; a spot first selected for this purpose but which the unreasonable demand of the owner induced me to reject. The Depot now selected will be indispensable whenever the contemplated canal communication is established, so I hope that their Lordships will approve of my motives in this instance without previous approbation."[1]

Anticipating the potential development of the area, he undoubtedly foresaw the establishment of a town when he acquired this property as well as a possible site for the canal entrance. In 1826 this tract of land, including about 400 acres, was transferred to Colonel John By who had been commissioned to direct the project:

> "I take this opportunity of meeting you here to place in your hand a sketch Plan of several lots of land, which I thought it advantageous to purchase for the use of Government, where this Canal was spoken of, as likely to be carried into effect. These not only contain the scite for the head locks, but they offer a valuable locality for a considerable village or town for the lodging of Artificers, and other necessary assistants in so great a work. I would propose that these be correctly surveyed, laid off in lots of 2 or 4 acres to be granted according to the means of the settlers."[2]

The second site proposed for the head locks was the Rideau Falls vicinity. In 1825 a commission of Royal Engineers reported to the Duke of Wellington: "This Fall (Rideau) may be easily turned and the mouth of the proposed canal be made to enter by a small Bay a few hundred yards lower down the Ottawa." (Ross, 1927). This proposal was rejected by

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[1] Letter dated June 18, 1823, cited by A.H.D. Ross, Ottawa Past and Present (Toronto: Musson Book Co. Ltd., 1927), p. 53.

[2] Letter to Col. John By, dated September 26, 1826, cited by Lucien Brault, op. cit., p. 57.

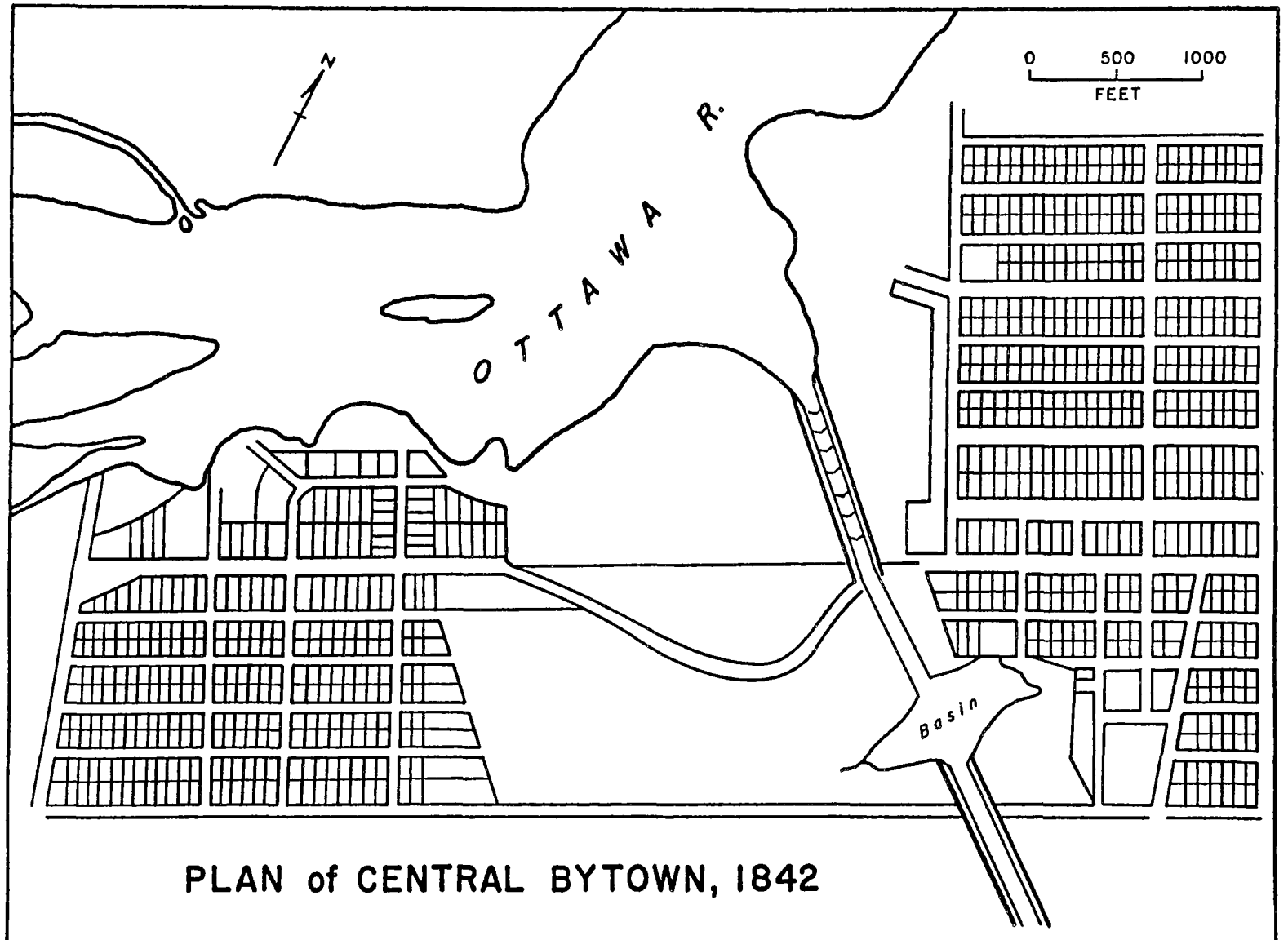
Colonel By partly because of the purchase price demanded and partly because of the high cost of rock excavation.

The Earl of Dalhousie and Lieutenant Colonel By chose the site between Parliament Hill and Major Hill Park as the most convenient location for the entrance of the canal on the Ottawa River.

3.1.2. Initial Surveys and Land Acquisitions: the Creation of a Townscape

Two major landowners, the Crown and Nicholas Sparks, played a decisive role in creating the mophological setting of the Ottawa central area. Once the site of the canal entrance had been chosen, the subdivision of land, to accommodate the various activities inherent to settlement, was the obvious first order of business. The rectangular network of blocks, the regular symmetry of property lines, reproduced by map 2, are the tangible legacies of these initial surveys. It is during this early period that the designations Upper Town, for the area west of the canal, and Lower Town, for the area east of the canal, were coined.

The first survey in Upper Town was initiated in 1826, under the direction of Colonel By, on Crown land bounded by the Ottawa River, Bank and Wellington streets, and Bronson avenue. The area was divided into lots of 66 feet frontage by 198 feet depth (Brault, p. 61). The size of properties in that area today bears little evidence to this initial parcelling, although some of these lots may appear on current cadastral plans. Nicholas Sparks adopted the same dimensions for the survey of his property bounded by Wellington-Rideau, Waller and Laurier streets, and Bronson avenue. This property has been purchased from John Burrows Honey



PLAN of CENTRAL BYTOWN, 1842

Source: Original map by D. Kennedy, reproduced by W. Eggleston in The Queen's Choice, 1961.

MAP 2

in 1823, the same year the Earl of Dalhousie acquired the Crown land. In view of the military importance of the canal, the strategic promontory along the Ottawa River including today's Parliament Hill, Major Hill Park (block 22) and Nepean Point Park,[1] was set aside for military purposes.

Lower Town, which became the larger village, was at first bounded by Murray street, the Rideau River, Rideau and Sussex streets. With few exceptions, the lots in this area were also surveyed following the dimensions set out in Upper Town. The unusual width of Wellington and Rideau streets is due to the foresight of Colonel By. He laid out Rideau street, situated on Crown land, with the uncommon width of 99 feet; he then pursuaded Nicholas Sparks to donate a strip of land 66 feet wide from his large property, to which a strip of 33 feet from Crown land was added, thus conforming the width of Wellington street to that of Rideau street.

The eastern section of the Sparks' land, west of the canal as indicated on map 2, was reserved until 1848 for the erection of fortifications which were never built. When the interdiction on this land was removed, the two towns began to grow toward each other.

3.2. A Comment on the City's Functional Evolution

By mid-nineteenth century, Ottawa and the other communities in the region derived their economic support primarily from timber; sawmilling developed taking advantage of the power potential of the area.

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[1] Nepean Point Park is located north of block 22, outside the boundaries of the study area.

In 1857 Ottawa was selected by the Queen as the capital of the Province of Canada, a choice that decided its fate as the capital of the Federal Union of Canada in 1867. In 1900, the city was a "flourishing industrial centre" (Eggleston, 1961); it was still the hub of the lumbering industry of eastern Canada as well as a leader in the manufacture of paper, matches and development of hydro-electric power. But employment in the federal civil service grew steadily; already in 1883 the space requirements for government activities exceeded the Ordinance Land on Parliament Hill and a location on the south side of Wellington street was chosen for expansion.

Ottawa's function as the national capital brought a gradual but decisive change in the nature of the city's economic base. Since the turn of the century, the major impetus to the region's growth has been its administrative function. A concentration of employment in professional and clerical occupations has developed but activities providing a wide range of services for the region have also increased rapidly with population growth. In 1971, Ottawa's metropolitan area population totalled 602,560. Employment in public administration and defense accounted for 36 percent of its labour force, manufacturing industries 8 percent.[1] In 1961 these figures totalled 33 and 10 percent indicating a relative decline for manufacturing industries during the decade.

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[1] As a basis for comparison, employment in manufacturing industries for Montreal and Toronto accounted for 30 and 31 percent of the labour force respectively in 1971.

CHAPTER IV

LAND OWNERSHIP

4.1. Significant Components of Land Ownership

4.1.1. Choice of Variables

From City assessment data five types of land ownership were specified: private, commercial, institutional, municipal and federal. Institutional ownership designates properties owned by religious bodies or associations and by school boards. The commercial class is an all inclusive category affecting properties owned by corporations and registered companies. National capital commission properties are considered federal properties since the N.C.C. is a federal agency whose policy is akin to federal land policy for the national capital. A sixth category, land owned by the province, had been included in the initial research but dropped from the analysis as it affected only one property in the study area located in block 79. The property involved was arbitrarily allocated to municipal ownership.

The choice of other variables was guided by the basic assumptions that ownership is related to land parcelling or fragmentation within the central area and to land value. This last relationship is obscured by the fact that municipal assessment records do not provide separate values for land and buildings on that land. Therefore the registered assessment value includes both value of the land and its building stock. For this reason, lot coverage was included in the first

analysis in an attempt to weight assessment value data.

4.1.2. First Analysis

4.1.2.1. Nonrotated Factor Matrix

In the study of property ownership, close attention is given to both nonrotated and rotated matrices. The purpose of this detailed analysis is to examine the strengths and weaknesses offered by both matrices and to observe to what extent factor structure is modified in order to arrive at a more knowledgeable interpretation of the results.

The eight factors specified involve 83.7 percent of the data's variance as indicated in table 2. The results of the analysis are not wholly unexpected. The importance of federal ownership, due to the capital status of the city, is ascertained. A spatial pattern already emerges from this ownership analysis, differentiating between a vague central core and peripheral zones within the eastern and western margins of the study area. Land fragmentation also appears as a distinctive element of the central area. In this respect, the analysis indicates that the parcelling of blocks, which is the result of historic lot surveys, is undergoing transformation as a response to the needs of a rapidly growing central business district.

The first nonrotated component opposes strongly dissected blocks to large properties in the central area. This land fragmentation is related to the type of property ownership: weakly parcelled properties are federally owned and associated with variables indicating size, high value and lot coverage. Blocks 43 and 53 are not federal properties as

TABLE 2

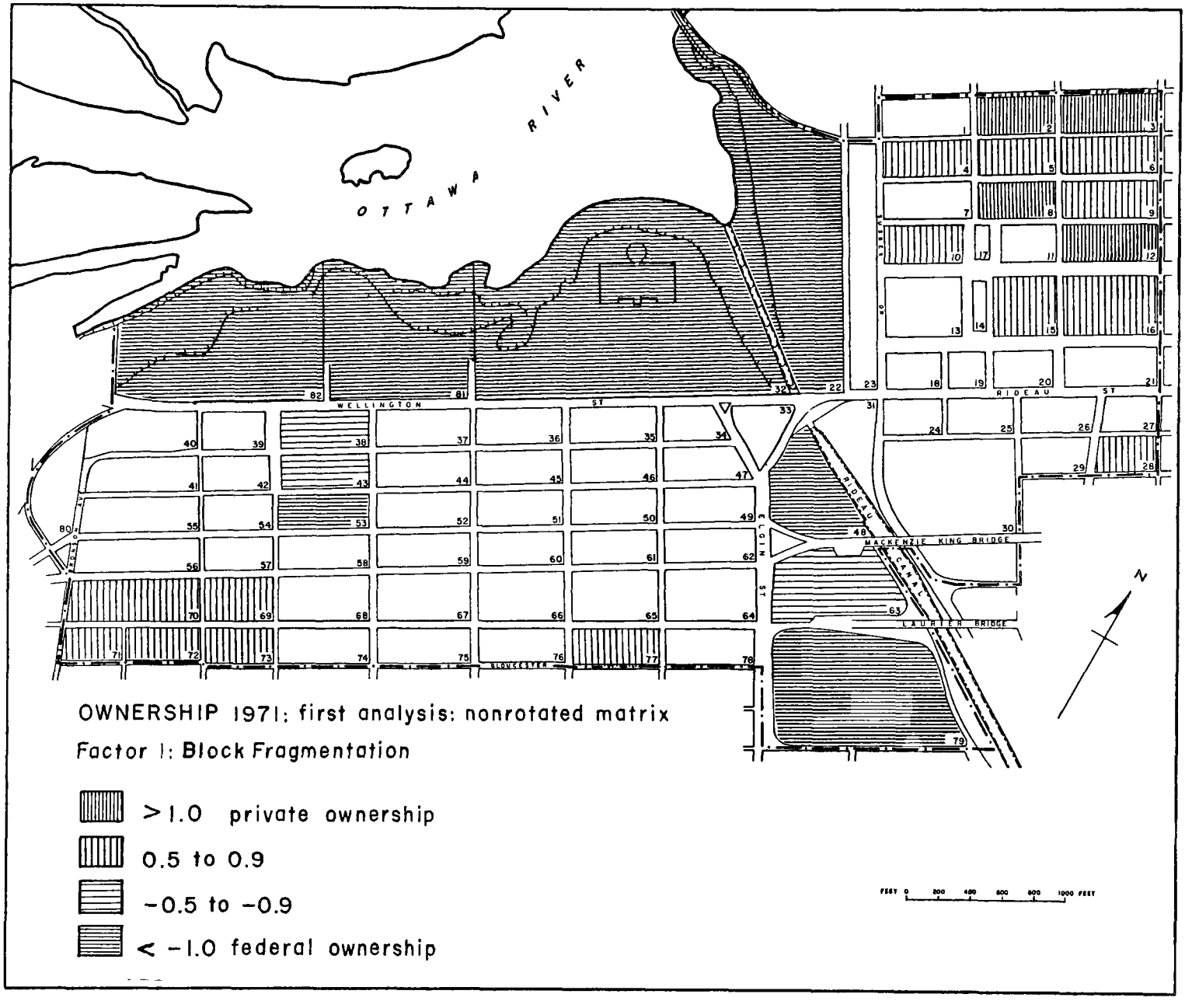
LAND OWNERSHIP 1971: FIRST ANALYSIS
NONROTATED FACTOR MATRIX

Factor Number		1	2	3	4	5	6	7	8
Eigenvalue		6.3	2.9	2.4	1.8	1.7	1.6	1.1	1.1
Percent of Total Variance		27.6	13.0	10.5	7.9	7.6	7.1	5.0	4.7
Variable	Communality	Block Fragmentation	Occupancy	Municipal and Institutional Ownership	Institutional vs Municipal Ownership	Commercial	High Value Private Ownership	Number of Properties	Number of Federal Properties
1. Tot. Owners	.924	.552	.712						
2. Tot. Properties	.890	.633	.616						
3. Tot. Owner Occupied	.790	.456	.713						
4. No. Prop.: Private	.861	.515	.651						
5. No. Prop.: Commercial	.853						.377	.566	-.452
6. No. Prop.: Institutional	.441				.429				
7. No. Prop.: Municipal	.613			.449				-.435	-.371
8. No. Prop.: Federal	.856					-.334	-.307	.313	.677
9. Average Size	.931	-.886	.313						
10. Size: Private	.801						.682	-.303	
11. Size: Commercial	.918		-.342			.819			
12. Size: Institutional	.956			.630	.616				
13. Size: Municipal	.805			.727	-.402				
14. Size: Federal	.926	.889	.343						
15. Average Value	.878	-.871							
16. Value: Private	.824						.807		
17. Value: Commercial	.869		-.372			.771			
18. Value: Institutional	.935			.660	.567				
19. Value: Municipal	.713			.628	-.520				
20. Value: Federal	.925	-.834	.338						
21. Block Size	.820	-.825							
22. Block Coverage	.815	-.595	.392						
23. Tot. Assessed Value	.889	-.878							

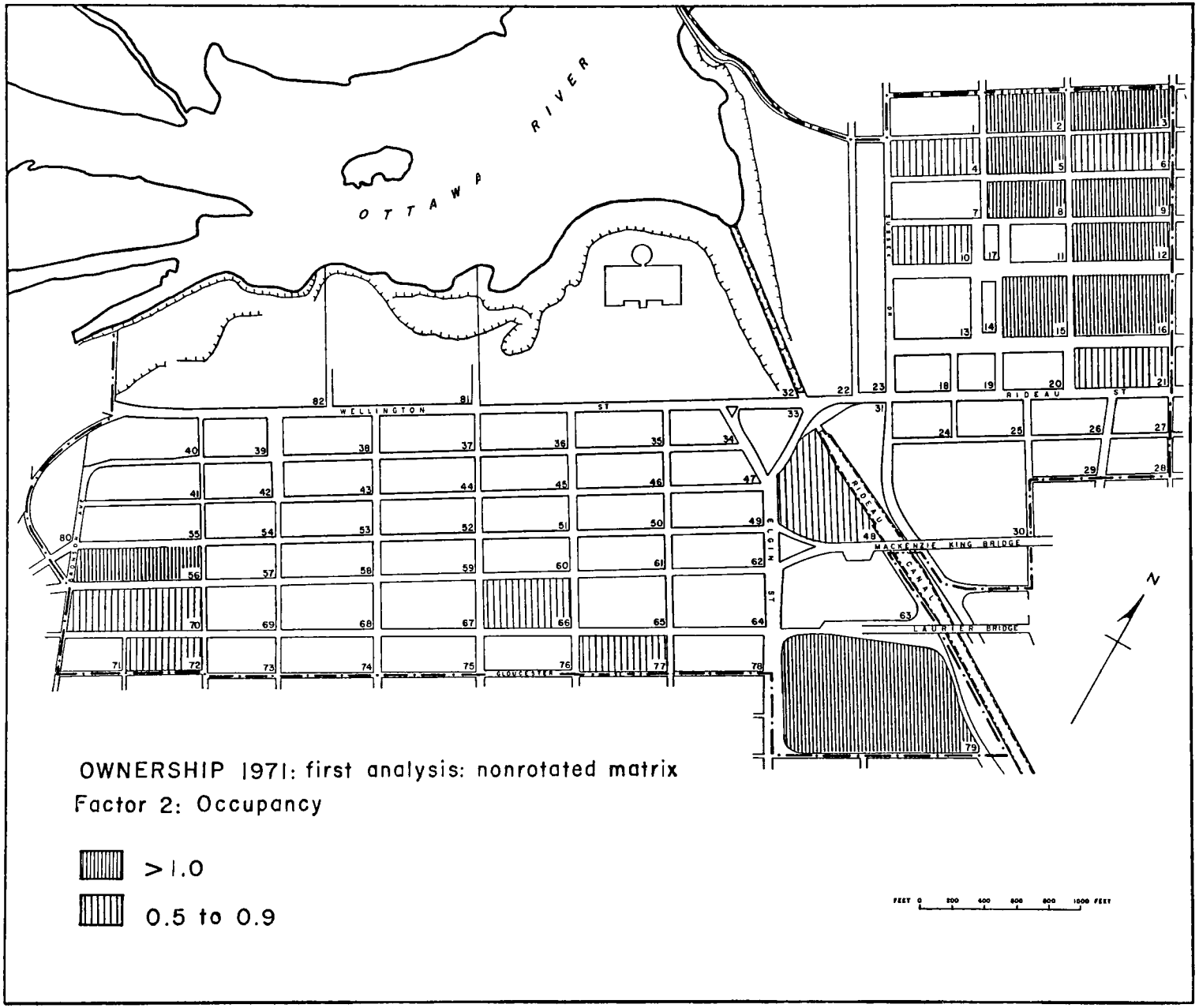
indicated on map 3 but their lot coverage, their average size and value share the characteristics attributed to federal ownership by the component. The dissected blocks are associated with private ownership. The moderate loading of 'total number of properties owner occupied' (.456) is indicative in this instance of residential occupation.

The second component repeats the same positive loadings but replaces the previous strong opposition by a weaker one to size (-.343) and value (-.372) of commercial property. 'Total number of properties owner occupied' obtains the highest loading for this component (.732). The previously established relationship with private residential ownership no longer holds; several types of ownership are now associated with 'owner occupied' (map 4): federal, (blocks 32 and 79) commercial, (block 66) and private. It is therefore not unexpected to find that privately owned lands, as specified by factor 1, should retain high factor score weights on the second component. In terms of private ownership, occupancy is revealed to be more significant for the Lower Town area. A visual comparison of maps 3 and 4 verifies this observation. In considering the negative aspect of the component, one can assume that tenancy is a characteristic which is more closely related to commercial ownership.

An association between municipal and institutional properties is revealed by the third component. One might assume that not only are they related in terms of value and size, but they also behave similarly in space (map 5). Entire blocks can be devoted to institutional (block 1) or municipal ownership (blocks 14 and 17). Most often, however, they occur with other types of ownership, such as in block 47 (city) or 56


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
ELGIN ST
RIDEAU CANAL
MACKENZIE KING BRIDGE
LAURIER BRIDGE
OWNERSHIP 1971: first analysis: nonrotated matrix
Factor 1: Block Fragmentation
>1.0 private ownership
0.5 to 0.9
-0.5 to -0.9
< -1.0 federal ownership
FEET 0 200 400 600 800 1000 FEET

MAP 3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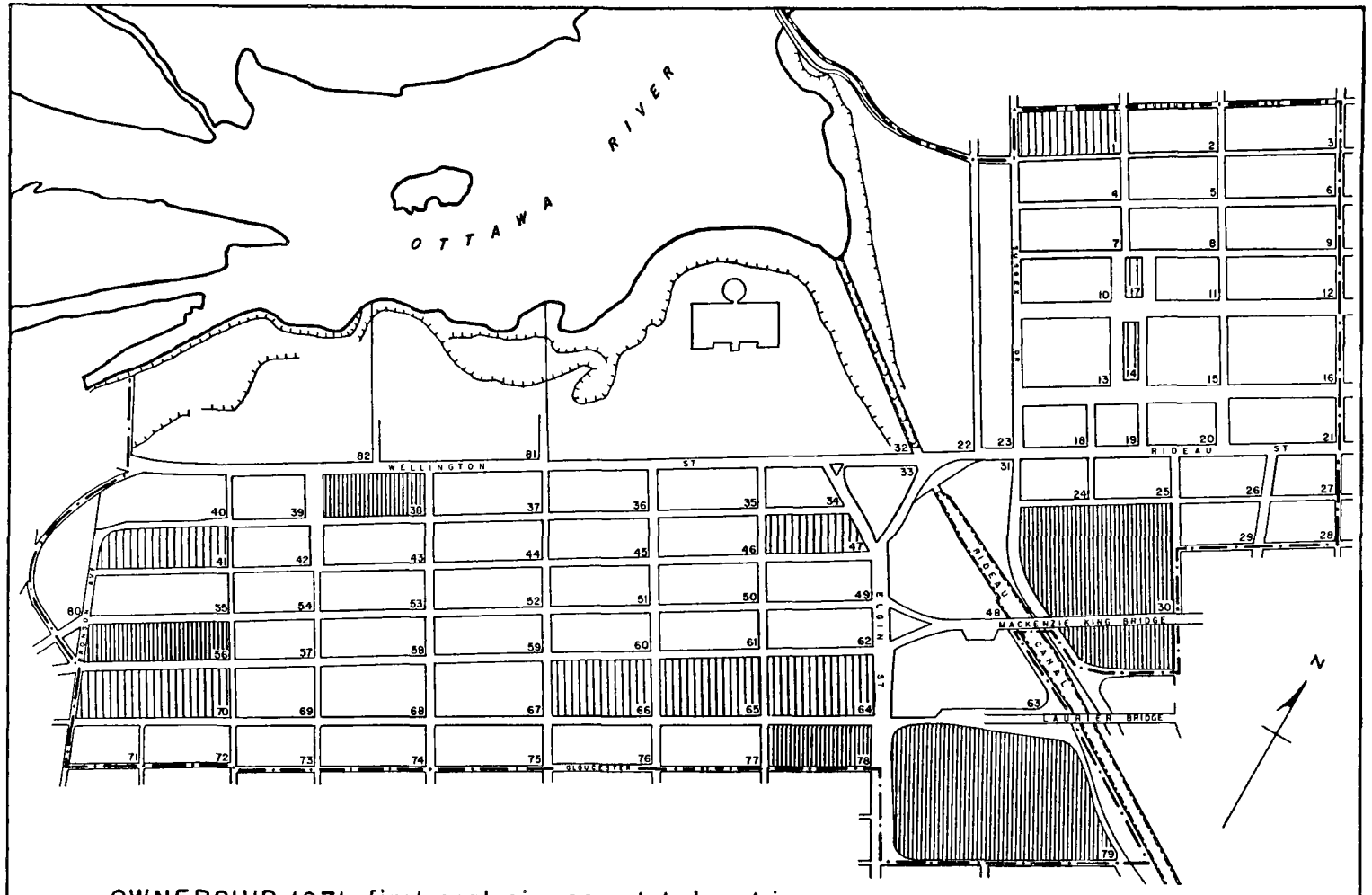
WELLINGTON ST
RIDEAU ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
OWNERSHIP 1971: first analysis: nonrotated matrix
Factor 2: Occupancy
>1.0
0.5 to 0.9

MAP 4

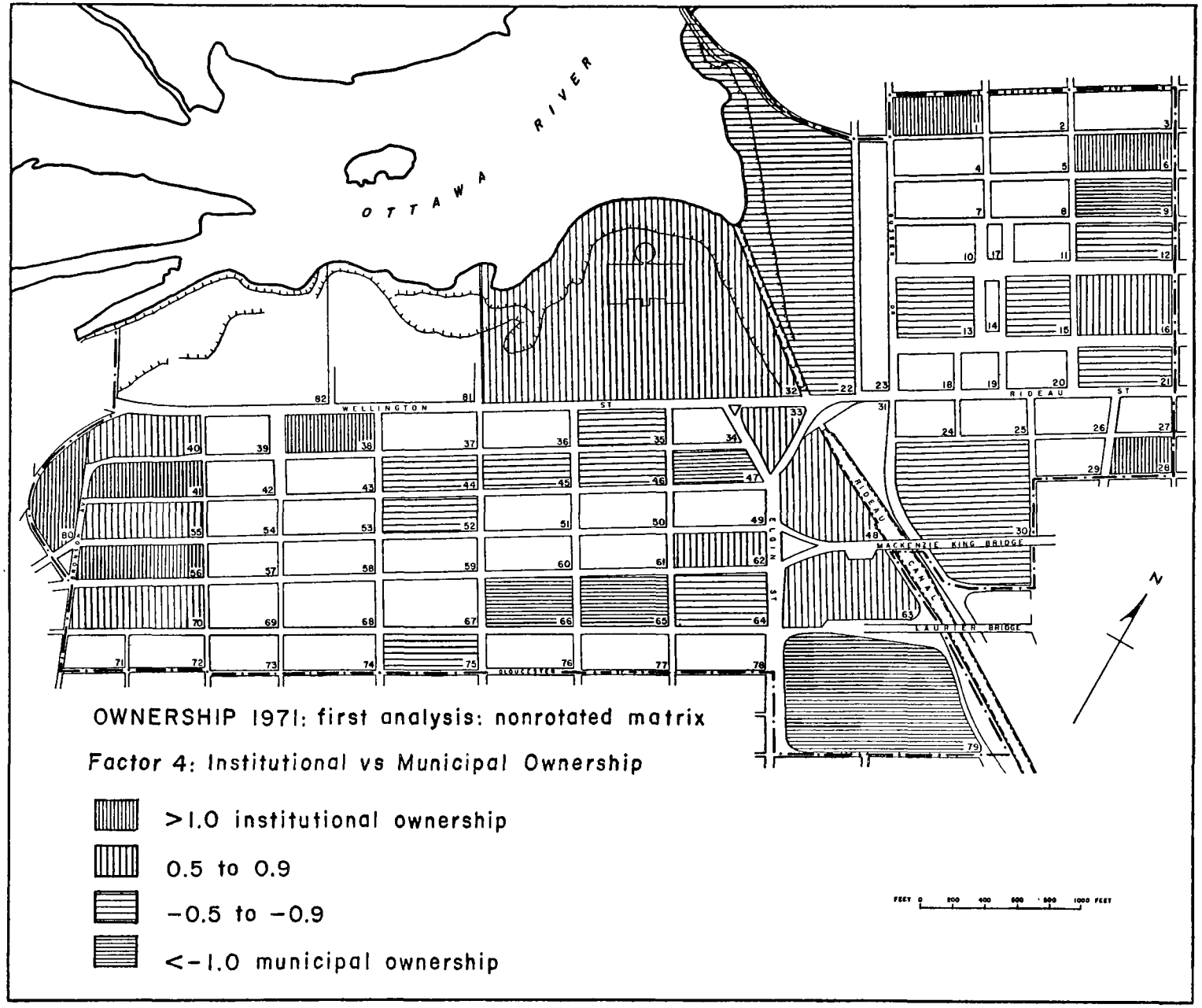

OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
MACKENZIE KING BRIDGE
RIDEAU CANAL
LAURIER BRIDGE
N
OWNERSHIP 1971: first analysis: nonrotated matrix
Factor 3: Municipal and Institutional Ownership
>1.0
0.5 to 0.9
FEET 0 200 400 600 800 1000 FEET

MAP 5

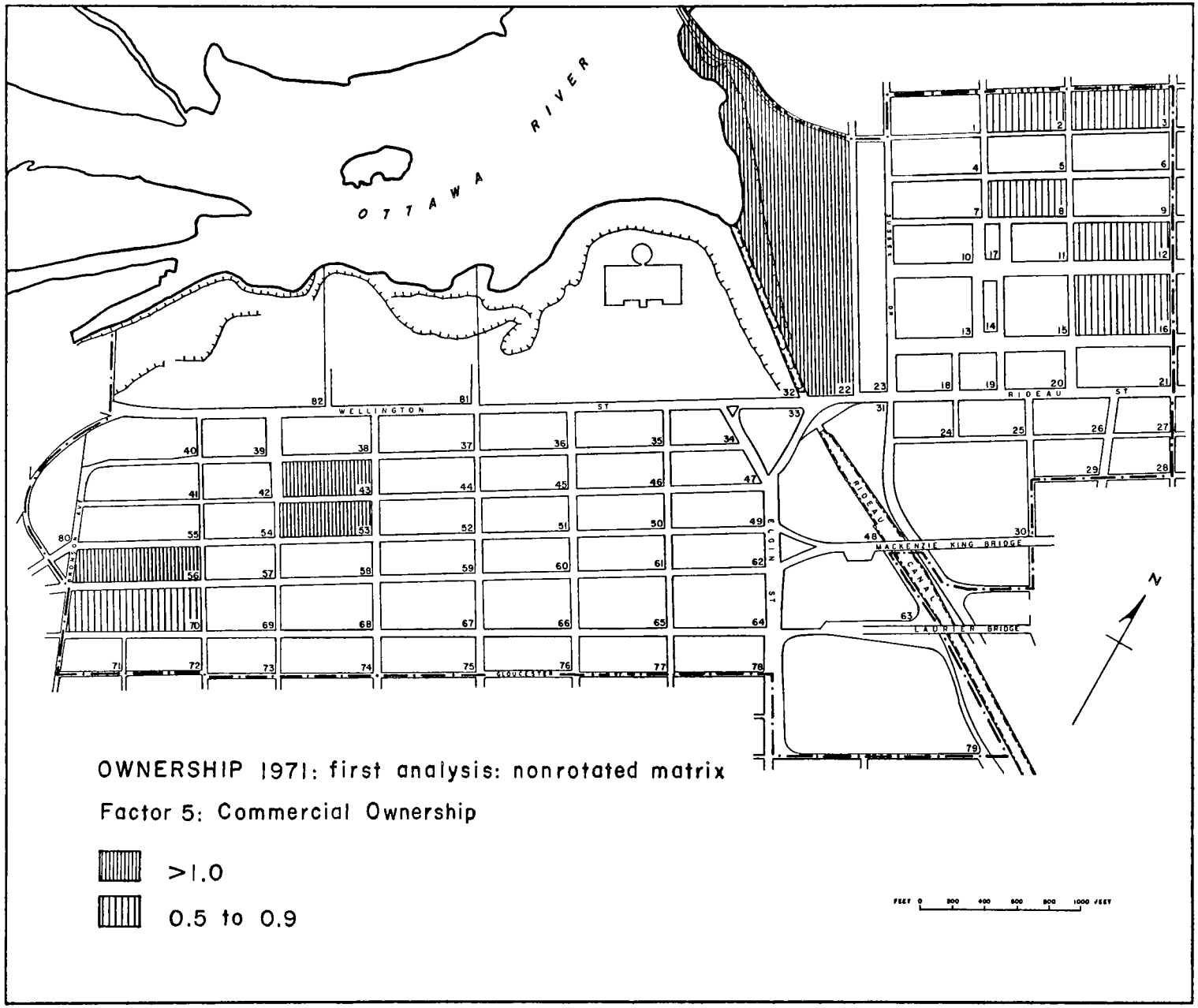
(institutional). In some instances they are found in the same block which include other types of ownership as well. This might explain the factor loadings. Institutional ownership occurs in 17 blocks and municipal ownership in 14 blocks; both types appear in five of these blocks, 41, 64, 70, 78, 79, all figuring in map 5 . This represents a high percentage of joint occurrence.

The following component nevertheless opposes these same types of ownership (map 6); variables related to institutionally owned properties load positively on this factor and variables related to municipal properties load negatively. The interpretation of factor scores seems obscured however by variables loading poorly on the factor. One can only attribute the inclusion of blocks 32, 33, 40, 48, 63 and 80 at the chosen 0.5 level of significance to the influence of the 'value of federal property' variable (.134), since none of these blocks incorporate institutional properties. It is perhaps more significant that these spatial units have another element in common; they are characterized by either absence of lot coverage (blocks 33, 40, 63) or limited lot coverage. Therefore the 'lot coverage' variable, which loads negatively on the component (-.287), also influences the factor score distribution.

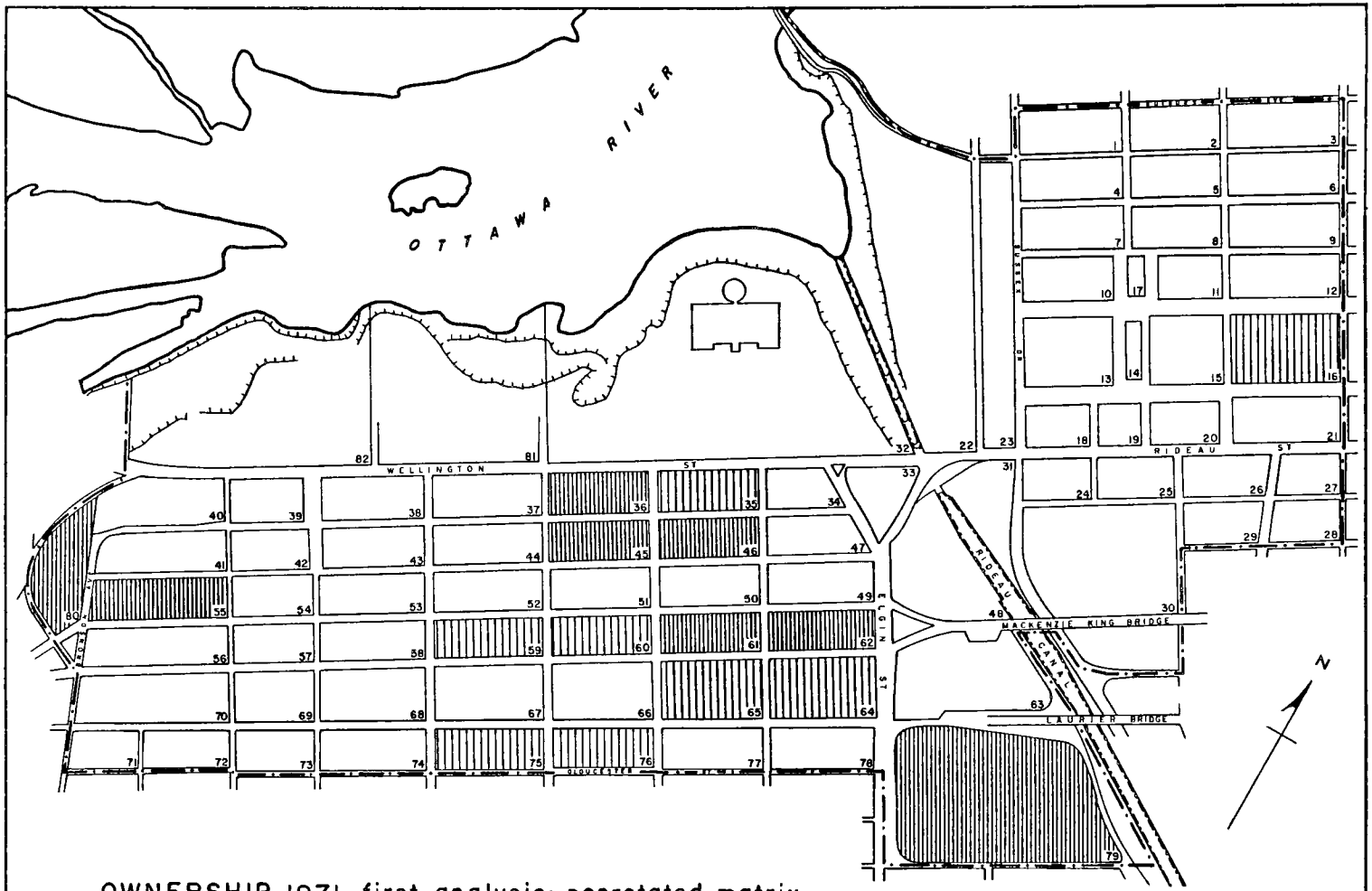
These results might be an indication of the importance of extreme values included within the original data matrix. It is normal to expect extreme values when dealing with land value data for the central area; such values are further inflated, in the Ottawa study by the large tracts of land controlled by the federal government. The standardized matrix does not have the property of minimizing extreme values and these data will therefore influence the factor score loadings. Had the


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
NICHOLAS ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
OWNERSHIP 1971: first analysis: nonrotated matrix
Factor 4: Institutional vs Municipal Ownership
>1.0 institutional ownership
0.5 to 0.9
-0.5 to -0.9
<-1.0 municipal ownership
FEET 0 200 400 600 800 1000 FEET

MAP 6


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
CANAL
RIDEAU
N
OWNERSHIP 1971: first analysis: nonrotated matrix
Factor 5: Commercial Ownership
>1.0
0.5 to 0.9

MAP 7



OWNERSHIP 1971: first analysis: nonrotated matrix

Factor 6: High Value Private Ownership

>1.0

0.5 to 0.9

MAP 8

assessed value and size of property distributions been log transformed, it is expected that the factor score loadings would have been altered at this level.[1] This is not to imply, however, that the factor structure would have been significantly transformed, for the influence of extreme data values generally disappears following orthogonal rotation.

The fifth component, Commercial Ownership, further underlines federal presence within the central area by indicating a negative relationship with number of federal properties (-.334). Map 7 singles out large properties (blocks 43 and 53), and commercial blocks characterized either by a large number of owners (blocks 8 and 12) or an occurrence with institutional ownership (blocks 2 and 16).

Factor 6, (map 8) identified by 'value of private ownership' (.808) and 'size of private ownership' (.682), shows a marked concentration in the central part of the study area. An association, high value private ownership and commercial ownership (number of commercial properties, .377) is established. This component also reflects a weak opposition to 'number of federal properties' (-.308).

The seventh and eighth components both relate to block fragmentation as measured by the total number of properties by type of

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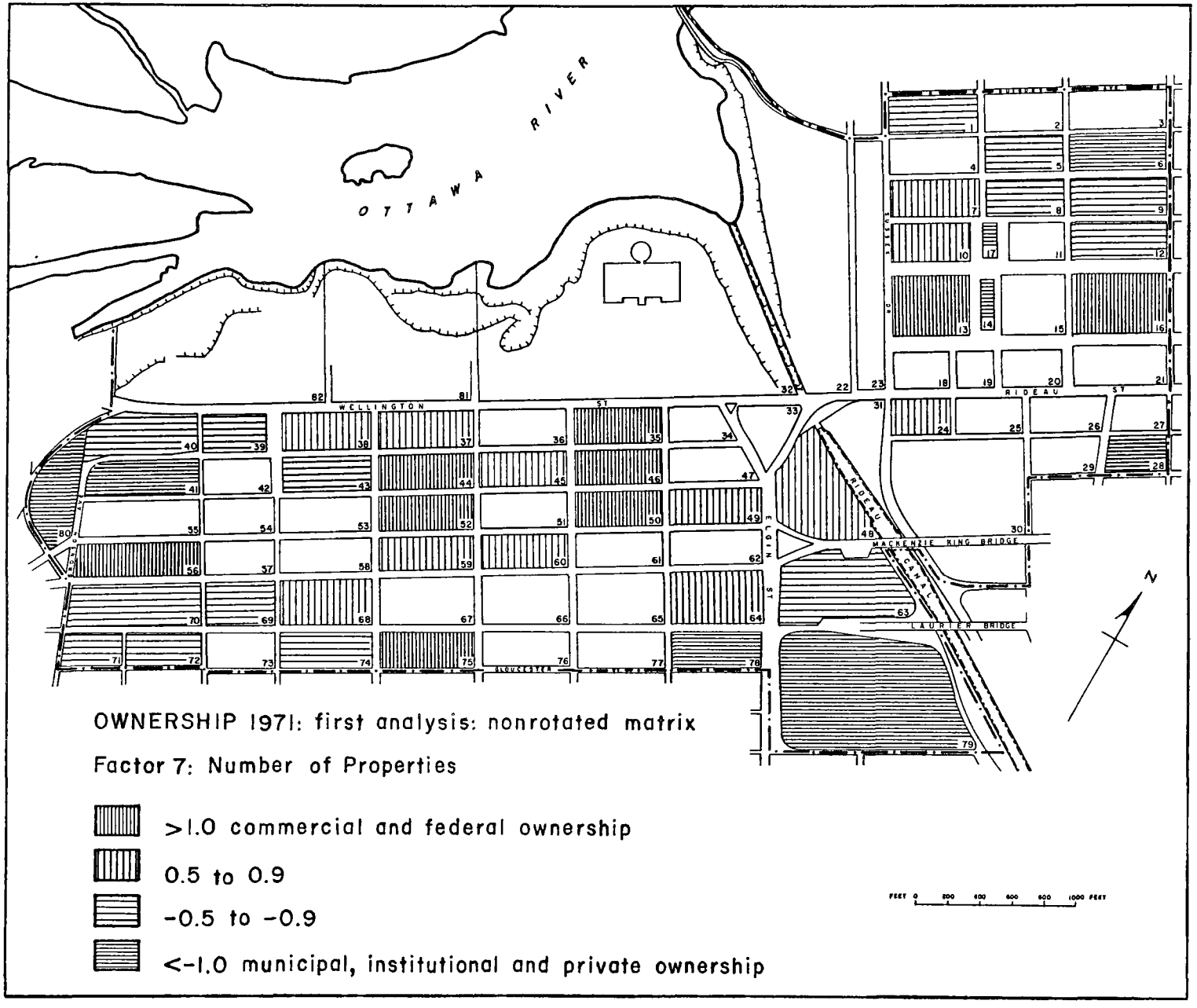
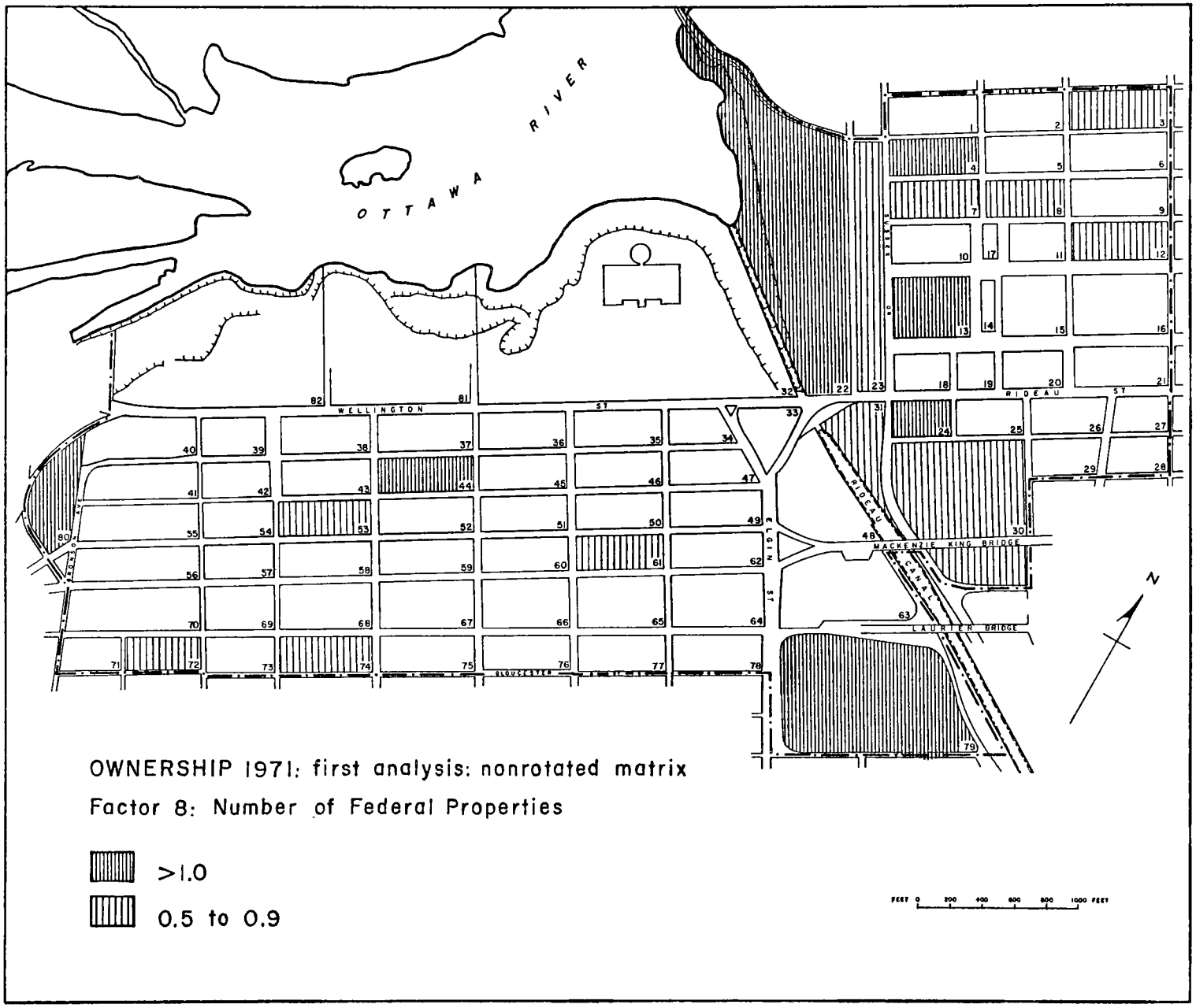
[1]This specific problem is studied by J.-B. Racine in his article entitled "Modèles graphiques et mathématiques en géographie humaine: III Les leçons d'un bilan critique, "Revue de Géographie de Montréal, XXVI (1972), pp. 321-32. A first analysis using non normalized data shows the disturbing influence of extreme values on factor scores resulting from the nonrotated matrix. Several, but not all, of these influences disappear from the factor scores resulting from the rotated matrix. A second analysis, incorporating the same data which has undergone normalization, reveals that disturbing influences resulting from extreme values are not eliminated. The factor structure remains the


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
ELGIN ST
RIDEAU CANAL
MACKENZIE KING BRIDGE
LAURIER BRIDGE
GLOUCESTER
OWNERSHIP 1971: first analysis: nonrotated matrix
Factor 7: Number of Properties
>1.0 commercial and federal ownership
0.5 to 0.9
-0.5 to -0.9
<-1.0 municipal, institutional and private ownership
FEET 0 200 400 600 800 1000 FEET

MAP 9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WELLINGTON ST
RIDEAU ST
ELGIN ST
RIDEAU CANAL
MACKENZIE KING BRIDGE
LAURIER BRIDGE
OWNERSHIP 1971: first analysis: nonrotated matrix
Factor 8: Number of Federal Properties
>1.0
0.5 to 0.9
N

MAP 10

ownership. Component 7 weakly opposes the parcelling of commercial and federal lands to municipal, institutional and private properties. The latter elements are strongly concentrated within the peripheries of the study area. A closer examination of commercial and federal properties indicates that they do not necessarily occur together; blocks 38 and 39, for example, do not include commercial properties and similarly blocks 16 and 56 do not include federal properties (map 9). The uniting bond is therefore the parcelling of the block unit. This parcelling is of course closely related to property size and value. The same observation could be formulated for the negative part of the component. The eighth component confirms this observation to some degree since it opposes federal properties to commercial and municipal properties (map 10). It is significant that 'size of private property' (.249) should also appear on this factor as block dissection has been linked to private ownership from the very first factor.

These two components explain 5.08 and 4.79 percent of the total variation respectively and the factor loadings are low thus indicating that these factors may not add significantly to the explanation of land ownership. The components and their factor scores may also express a spatial complexity which defies generalization.

4.1.2.2. Rotated Factor Matrix

The rotated factor matrix gives a much clearer picture of the structure of land ownership in the Ottawa central area (table 3). It

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same however.

TABLE 3

LAND OWNERSHIP 1971: FIRST ANALYSIS
ROTATED FACTOR MATRIX

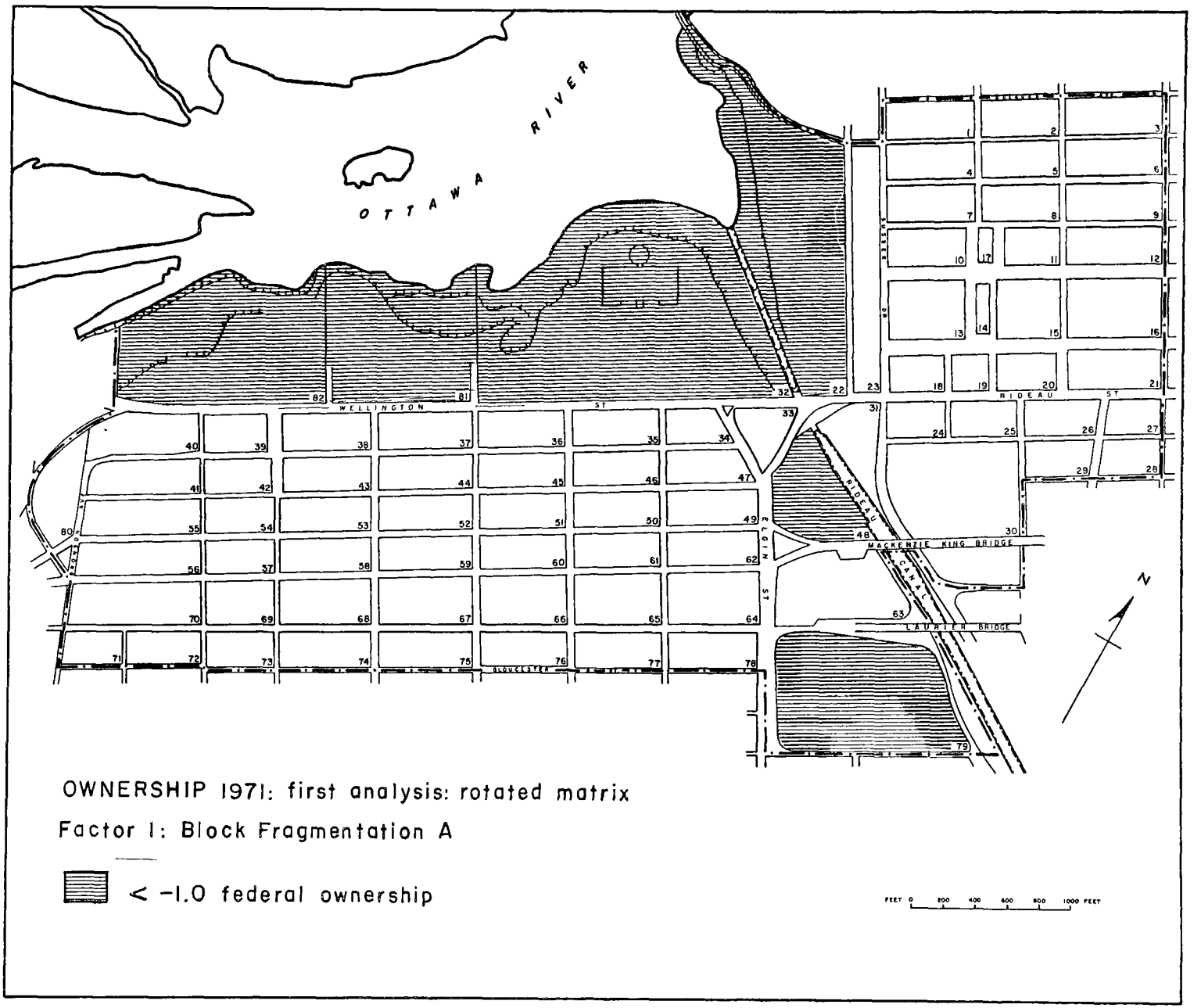
Factor Number	1	2	3	4	5	6	7	8
Eigenvalue	5.5	3.4	2.1	2.0	1.9	1.6	1.3	1.2
Percent of Total Variance	24.2	14.9	9.1	8.8	8.3	7.0	5.8	5.3

Variable	Block Fragmentation A	Block Fragmentation B	Municipal Ownership	Institutional Ownership	High Value Commercial Ownership	High Value Private Ownership	Number of Properties	Number of Federal Properties
1. Tot. Owners		.923						
2. Tot. Properties		.872						
3. Tot. Owner Occupied		.877						
4. No. Prop.: Private		.882						
5. No. Prop.: Commercial							.860	
6. No. Prop.: Institutional							-.530	
7. No. Prop.: Municipal			.621					-.410
8. No. Prop.: Federal								.895
9. Average Size	-.946							
10. Size: Private						.869		
11. Size: Commercial					.945			
12. Size: Institutional				.962				
13. Size: Municipal			.869					
14. Size: Federal	-.945							
15. Average Value	-.907							
16. Value: Private						.886		
17. Value: Commercial					.913			
18. Value: Institutional				.961				
19. Value: Municipal			.830					
20. Value: Federal	-.918							
21. Block Size	-.849							
22. Block Coverage	-.656		.431				.302	
23. Tot. Assessed Value	-.868							

eliminates the redundancy of variables for which factor loadings appeared more or less significantly on more than one factor in the nonrotated matrix. The significance of this transformation is further revealed by the mapping of factor scores. These loadings clearly identify those blocks which have strong associations with the new clusters of inter-related variables. By the same token some information is lost. The bipolarity of the first factor in the nonrotated matrix gives way to two group factors retaining essentially the same information. The occupancy or tenancy component, which had been identified by the variable 'total owner occupied' in the second factor, disappears; its relationship with private ownership remains but its interesting opposition to commercial properties can no longer be verified. However, the correlation matrix (table 4) had not revealed a significant negative relationship between this variable and 'size of commercial ownership' (-.208) or 'value of commercial ownership' (-.213).

Factors 1 and 2, which account for 24.2 and 14.9 percent of the total variance respectively, identify the fragmentation of land within the central area (maps 11 and 12). Factor 1 emphasizes the importance of large federal land holdings whereas factor 2 exhibits strong block dissection where private ownership is significant. A cartographic analysis of these components clearly distinguishes federal properties centered on Parliament Hill and the western flank of the Rideau Canal. The smaller properties are concentrated in Lower Town with a secondary concentration in the south western corner of the study area.

Factors 3, 4, 5 and 6 distinguish the relative importance of municipal, institutional, commercial, and private ownerships.


OTTAWA RIVER
WELLINGTON ST
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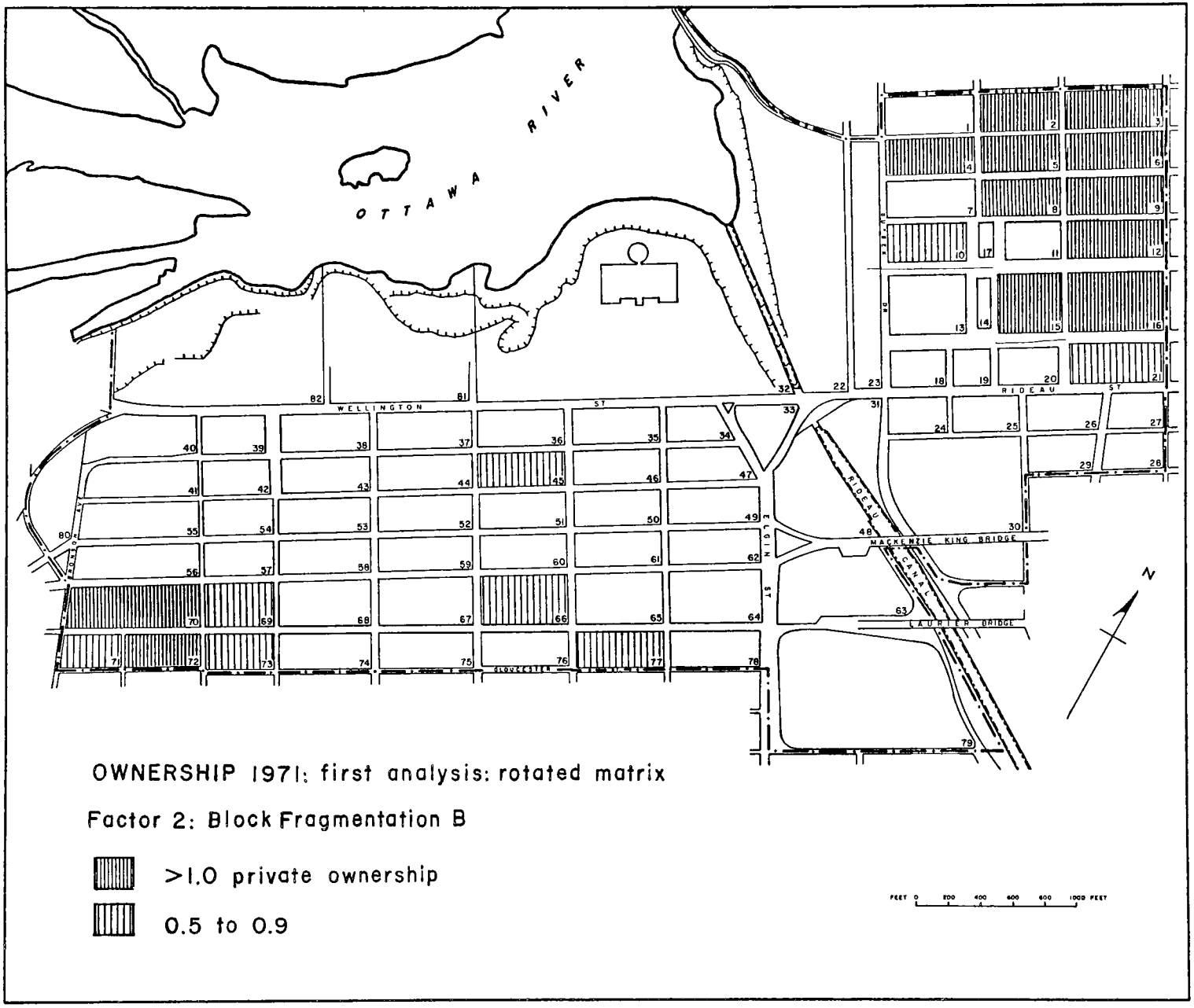
SUSSEX DR
ELGIN ST
RIDEAU CANAL
MACKENZIE KING BRIDGE
LAURIER BRIDGE
GLOUCESTER
N
FEET 0 200 400 600 800 1000 FEET
OWNERSHIP 1971: first analysis: rotated matrix
Factor 1: Block Fragmentation A
< -1.0 federal ownership

MAP 11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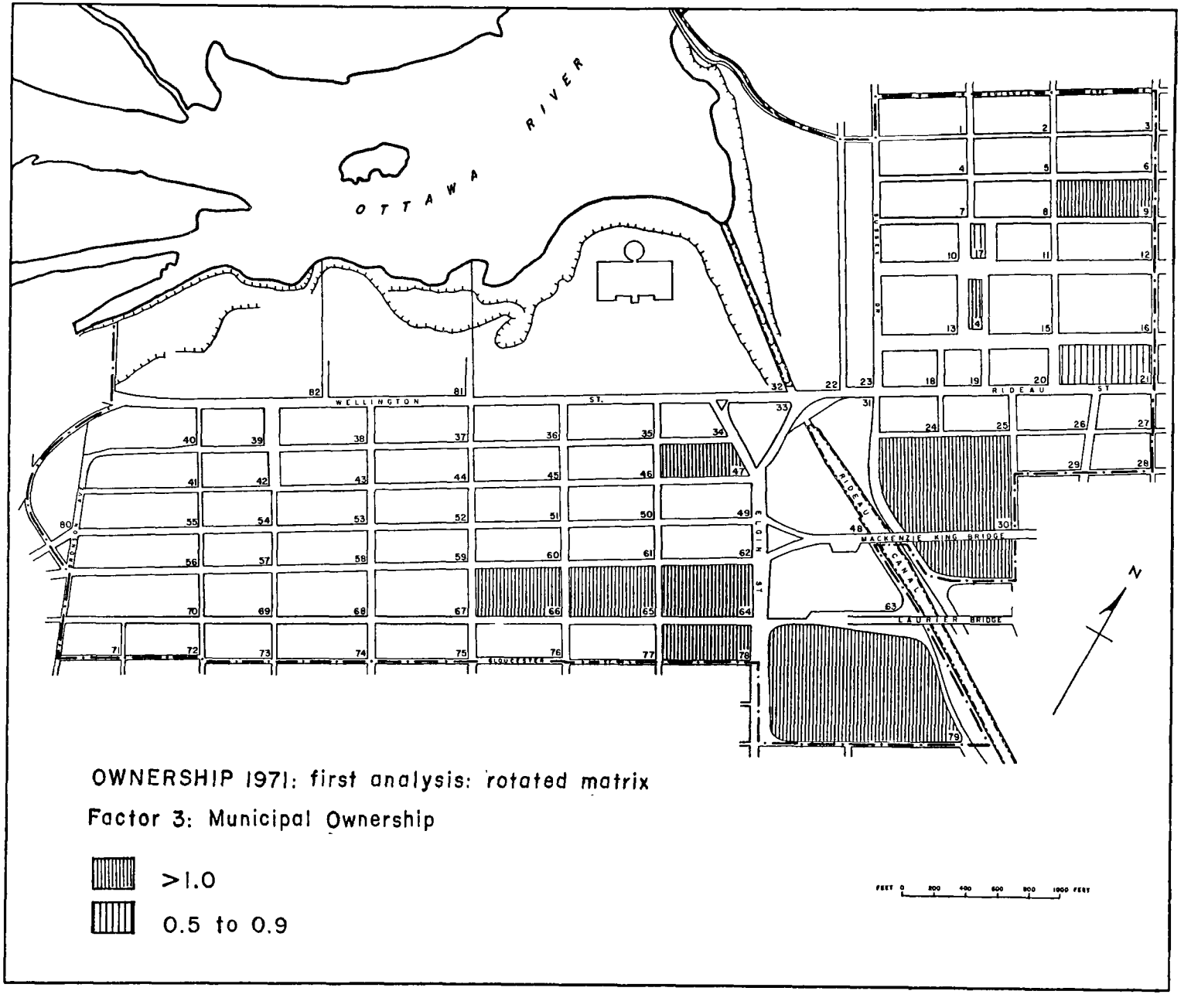
N
OWNERSHIP 1971: first analysis: rotated matrix
Factor 2: Block Fragmentation B
>1.0 private ownership
0.5 to 0.9
FEET 0 200 400 600 800 1000 FEET

MAP 12

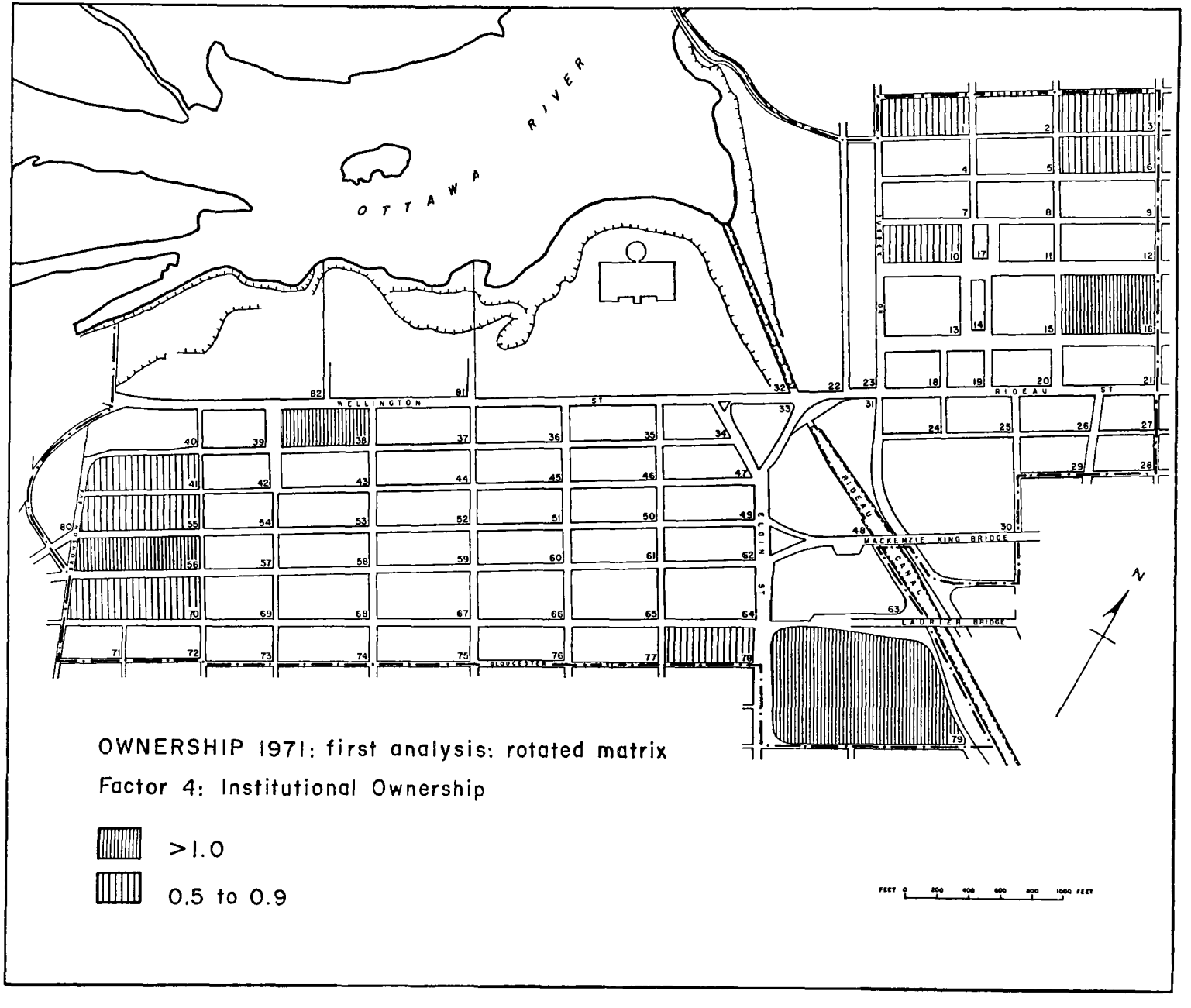
Institutional ownership is the only type which shows a distinctly peripheral distribution (map 14). Municipal ownership is found in the Lower Town area but also west of the Rideau Canal (map 13). Since the components emphasize size and value of properties, it is not surprising to find that blocks strongly associated with commercial and private ownership are mostly located in the central part of the study area. Blocks 43 and 53 from map 15 are examples of block redevelopment in the Ottawa CBD in recent years; they include the Place de Ville complex, the Skyline and Holiday Inn Hotels. Block 80 from map 16, located at the western margin of the study area, includes a privately owned luxury apartment. Such constructions are indicative of the type of redevelopment taking place in recent years in the Ottawa CBD.

The concentration of commercial ownership, both in Lower Town and Upper Town is clearly shown on map 17. The number of properties being the distinguishing element for factor 7, it is normal that blocks 43 and 53 are excluded. Similarly component 8 specifies those blocks for which the number of federal properties is significant. Several properties along Sussex drive, included within federal ownership category, are owned by the National Capital Commission. The distribution, as shown in map 18 , indicates that N.C.C. ownership can be distinguished from large federal holdings in the central area.

The factor score loadings are not as decisive in segregating the types of ownership identified by these two factors. Two main facts explain this phenomenon. Firstly, each factor is identified by a single high positive loading and by a single weaker negative loading. Secondly, 'lot coverage' is the second highest loading for both factors and strongly


OTTAWA RIVER
WELLINGTON ST.
RIDEAU ST
ELGIN ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
CANAL
N
OWNERSHIP 1971: first analysis: rotated matrix
Factor 3: Municipal Ownership
>1.0
0.5 to 0.9
FEET 0 200 400 600 800 1000 FEET

MAP 13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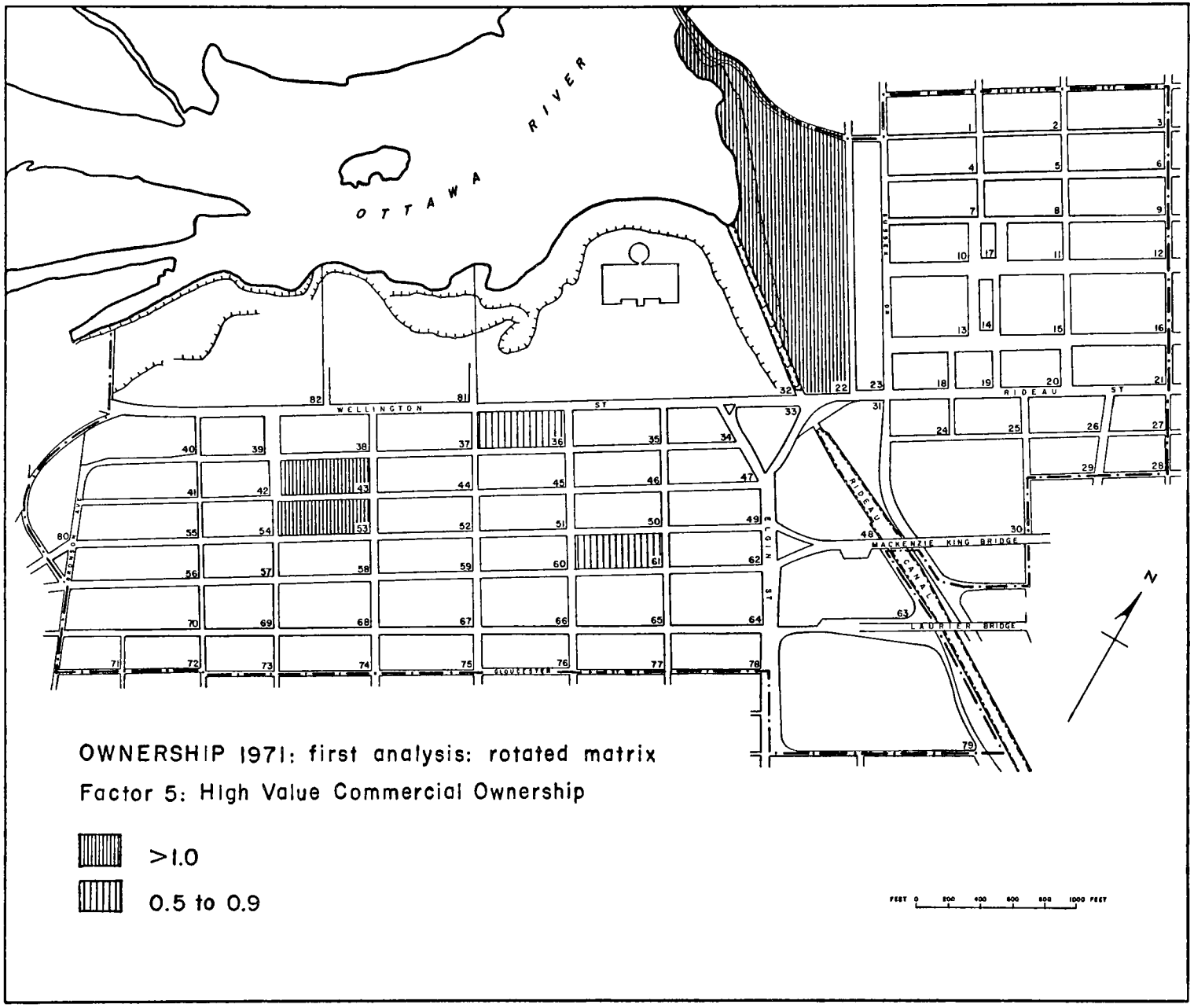
WELLINGTON ST
RIDEAU ST
RIDEAU CANAL
MACKENZIE KING BRIDGE
LAURIER BRIDGE
ELGIN ST
OWNERSHIP 1971: first analysis: rotated matrix
Factor 4: Institutional Ownership
>1.0
0.5 to 0.9
N

MAP 14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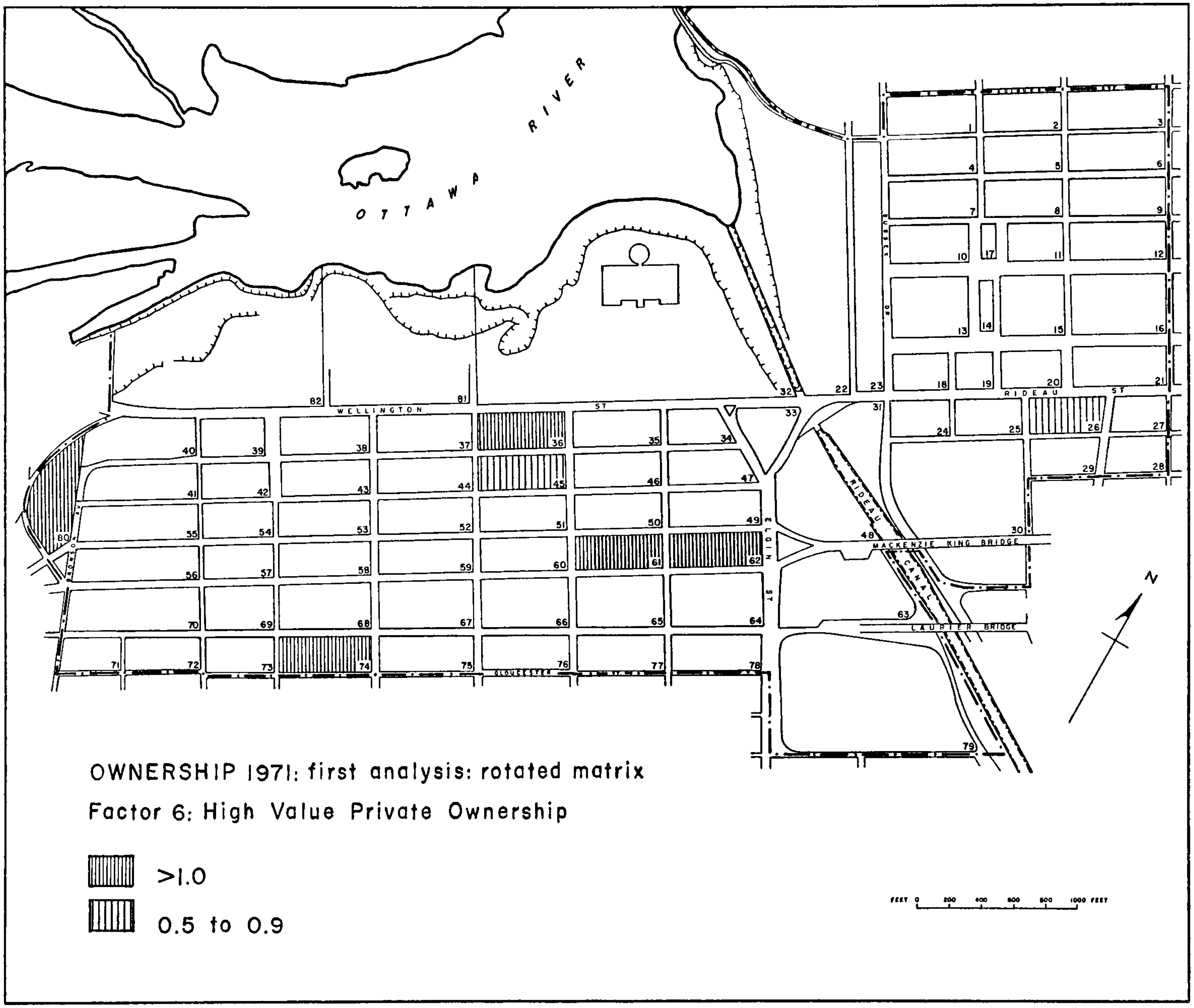
MACKENZIE KING BRIDGE
LAURIER BRIDGE
CANAL
RIDEAU
ELGIN ST
GLOUCESTER
OWNERSHIP 1971: first analysis: rotated matrix
Factor 5: High Value Commercial Ownership
>1.0
0.5 to 0.9
FEET 0 200 400 600 800 1000 FEET

MAP 15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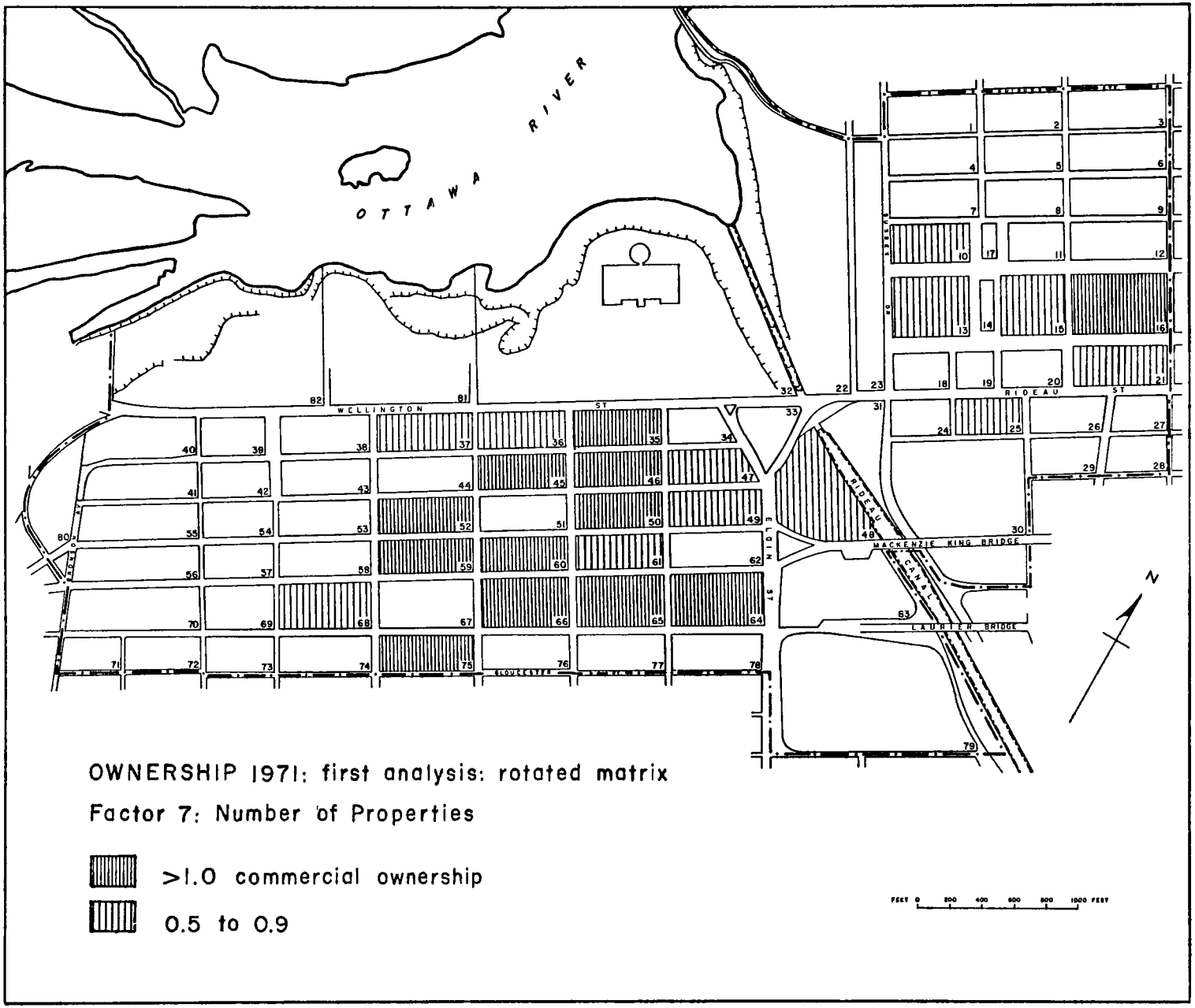
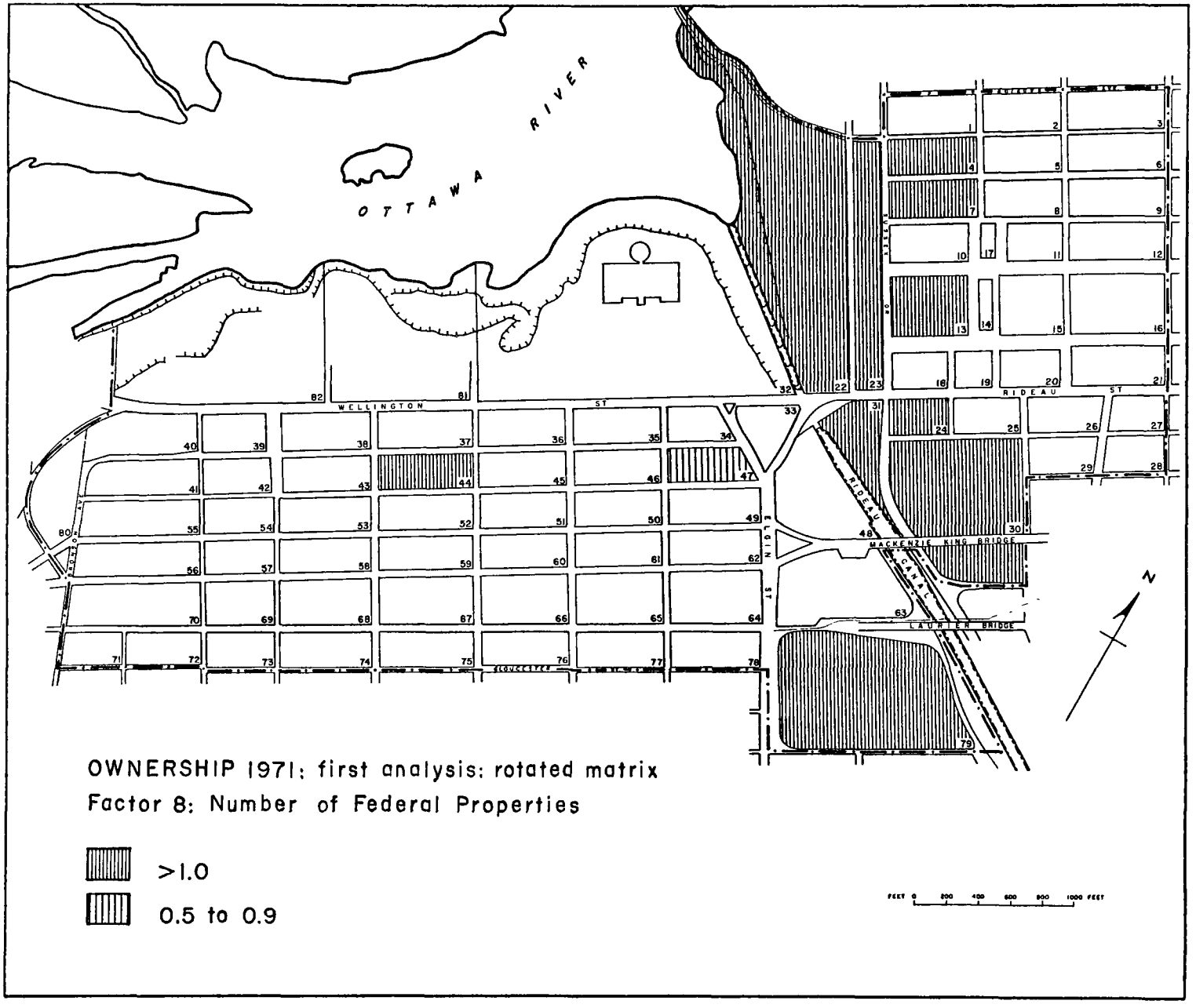
RIDEAU ST
ELGIN ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
RIDEAU CANAL
N
OWNERSHIP 1971: first analysis: rotated matrix
Factor 6: High Value Private Ownership
>1.0
0.5 to 0.9

MAP 16


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
RIDEAU CANAL
MIDLEIN ST
GLOUCESTER
OWNERSHIP 1971: first analysis: rotated matrix
Factor 7: Number of Properties
>1.0 commercial ownership
0.5 to 0.9
N

MAP 17


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
CANAL
N
OWNERSHIP 1971: first analysis: rotated matrix
Factor 8: Number of Federal Properties
>1.0
0.5 to 0.9
FEET 0 200 400 600 800 1000 FEET

MAP 18

influences the cartographic distribution. For these reasons only positive factor scores were retained for mapping.

4.1.3. Second Analysis

4.1.3.1. Data Reduction

The first level analysis suggests the possibility of reducing data to retain only those variables pertinent in establishing a pattern of land ownership within the central area. An examination of the communality of each variable[1] shows that the variables 'number of properties' by type of ownership have the lowest values. These variables are further associated with the last two factors in both the rotated and nonrotated matrices and account for only a small percentage of the total variance. The variables 'average size of property' and 'average value of property' which are strongly correlated, behave in a similar way; both are correlated with the same variables (table 4) and their factor loadings emphasize a strong relationship with federal ownership. Although their communality values are high it can be assumed that these variables do not add significantly to the explanation of land ownership. The variable 'lot coverage' acts as a potent differentiating element for several factors. Although it does not weigh equally on all components, its effect on factor scores, and therefore on the cartographic interpretation, is often significant. Its hypothesized relationship to

---

[1] The communality of each variable is defined by Rummel as the proportion of a variable's total variance that is accounted for by the factors: R.J. Rummel, Applied Factor Analysis (Evanston: Northwestern University Press, 1970), p. 142.

TABLE 4

LAND OWNERSHIP 1971:
CORRELATION MATRIX

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1.	Tot. Owners	1.00																						
2.	Tot. Properties	.81	1.00																					
3.	Tot. Owner Occupied	.82	.72	1.00																				
4.	No. Prop.: Private	.81	.81	.65	1.00																			
5.	No. Prop.: Commercial		.31			1.00																		
6.	No. Prop.: Institutional						1.00																	
7.	No. Prop.: Municipal							1.00																
8.	No. Prop.: Federal								1.00															
9.	Average Size		.34							1.00														
10.	Size: Private										1.00													
11.	Size: Commercial											1.00												
12.	Size: Institutional												1.00											
13.	Size: Municipal							.34						1.00										
14.	Size: Federal		.34							.97					1.00									
15.	Average Value		.37							.85						1.00								
16.	Value: Private										.58						1.00							
17.	Value: Commercial											.80						1.00						
18.	Value: Institutional												.93						1.00					
19.	Value: Municipal													.63						1.00				
20.	Value: Federal		.32							.85					.83	.94					1.00			
21.	Block Size		.32							.88		.33			.92	.64					.64	1.00		
22.	Block Coverage									.48				.49	.56	.48				.33	.48	.59	1.00	
23.	Tot. Assessed Value	.30	.42		.37					.76					.74	.87					.82	.66	.67	1.00

assessed value is limited however. This observation is not based on the correlation values associated with the variable (table 4), but on the fact that it is only a partial estimate of building stock at the block level. For this reason, it can be removed from the land ownership study but retained for the structural analysis.

4.1.3.2. The Basic Structure of Land Ownership

The factor loadings of the second land ownership analysis are indicated in tables 5 and 6. A hasty interpretation of the rotated factor loadings would lead to the conclusion that types of ownership are mutually exclusive at the block level. The first analysis indicated that this is not necessarily the case and this was substantiated by the cartography of factor scores. Antagonism between types of ownership remains the main theme of the nonrotated matrix however.

The analysis of the rotated factor loading matrix clearly asserts the importance of federal land ownership in the Ottawa central area. Large federal properties generally exclude other types of ownership. Commercial ownership has a tendency to exhibit similar characteristics as shown by blocks 43 and 53. Large properties are nevertheless the exception in the study area. Of 17 blocks which have a single owner, 10 are federal properties, 4 commercial, 2 municipal and 1 institutional.[1] Block fragmentation therefore accounts for 17.3 percent of the variance.

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[1] One block may have more than one owner and be classified within a single type of ownership.

TABLE 5

LAND OWNERSHIP 1971: SECOND ANALYSIS:
NONROTATED FACTOR MATRIX

Factor Number		1	2	3	4	5	6
Eigenvalue		4.16	2.3	1.9	1.6	1.5	1.3
Percent of Total Variance		27.7	15.5	13.2	11.2	10.2	9.1
Variable	Communality	High Value Federal Ownership	Block Fragmentation	Institutional Ownership	High Value Commercial Ownership	Municipal Ownership	High Value Private Ownership
1. Tot. Owners	.910	.653	.367	.388			
2. Tot. Properties	.843	.727		.374			
3. Tot. Owner Occupied	.858	.577	.456	.386	.304		
10. Size: Private	.781				-.586	-.333	.478
11. Size: Commercial	.915	-.360	-.380		.608	-.384	
12. Size: Institutional	.968		.615	-.566		-.463	
13. Size: Municipal	.827		.466	-.379		.453	.487
14. Size: Federal	.932	-.822	.379	.319			
16. Value: Private	.822		-.320		-.575		.547
17. Value: Commercial	.881	-.342	-.430		.549	-.345	
18. Value: Institutional	.965		.590	-.619		-.421	
19. Value: Municipal	.819		.312	-.354		.568	.504
20. Value: Federal	-.899	-.742	.331	.428			
21. Block Size	-.840	-.787	.327				
23. Tot. Assessed Value	-.814	-.826					

TABLE 6

LAND OWNERSHIP 1971: SECOND ANALYSIS:
ROTATED FACTOR MATRIX

Factor Number	1	2	3	4	5	6
Eigenvalue	3.3	2.5	1.9	1.8	1.6	1.6
Percent of Total Variance	22.4	17.3	13.0	12.6	11.0	10.6

Variable	Federal Ownership	Block Fragmentation	Institutional Ownership	High Value Commercial Ownership	Municipal Ownership	High Value Private Ownership
1. Tot. Owners		.938				
2. Tot. Properties		.859				
3. Tot. Owner Occupied		.916				
10. Size: Private						.868
11. Size: Commercial				.944		
12. Size: Institutional			.977			
13. Size: Municipal					.890	
14. Size: Federal	.953					
16. Value: Private						.899
17. Value: Commercial				.925		
18. Value: Institutional			.977			
19. Value: Municipal					.902	
20. Value: Federal	.906					
21. Block Size	.875					
23. Tot. Assessed Value	.860					

Since a relationship between municipal and institutional ownerships is not indicated by the correlation estimates, this relationship must largely be explained by their joint occurrence in several blocks. Private ownership explains a smaller percentage of the total variance. This may underline its subordinate position in terms of the selected size and value criteria but also its complex situation in relation to other types of ownership.

The cartography of factor scores (maps 19 to 22) shows no significant departure from that of the previous analysis.[1] The components isolate large size and high value and this generally leads to the identification of blocks characterized by a single type of ownership. The paucity of representative blocks therefore emphasizes the complexity of land ownership in the study area. It may be hypothesized that the complexity of land ownership is a distinguishing feature of the central area. In other words, the heterogeneous character of land ownership occurs with greatest frequency within and in proximity to the CBD.

A more thorough analysis of land ownership would include an enquiry into local versus non-local ownership. For example, several parcels of land in the study area are owned by City Parking Holdings, a Toronto based company who got into the development business through the ownership of central parking lots.[2]

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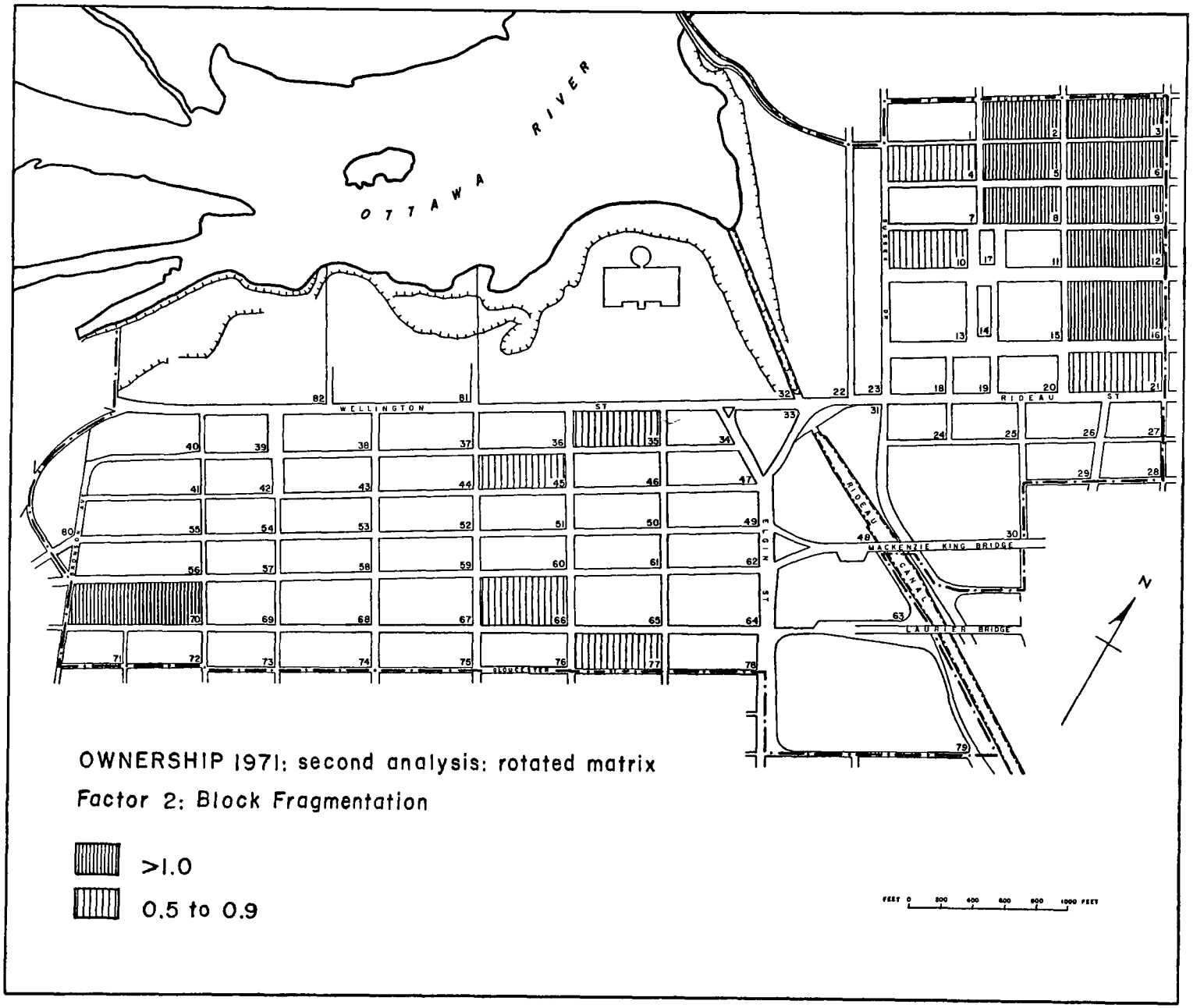
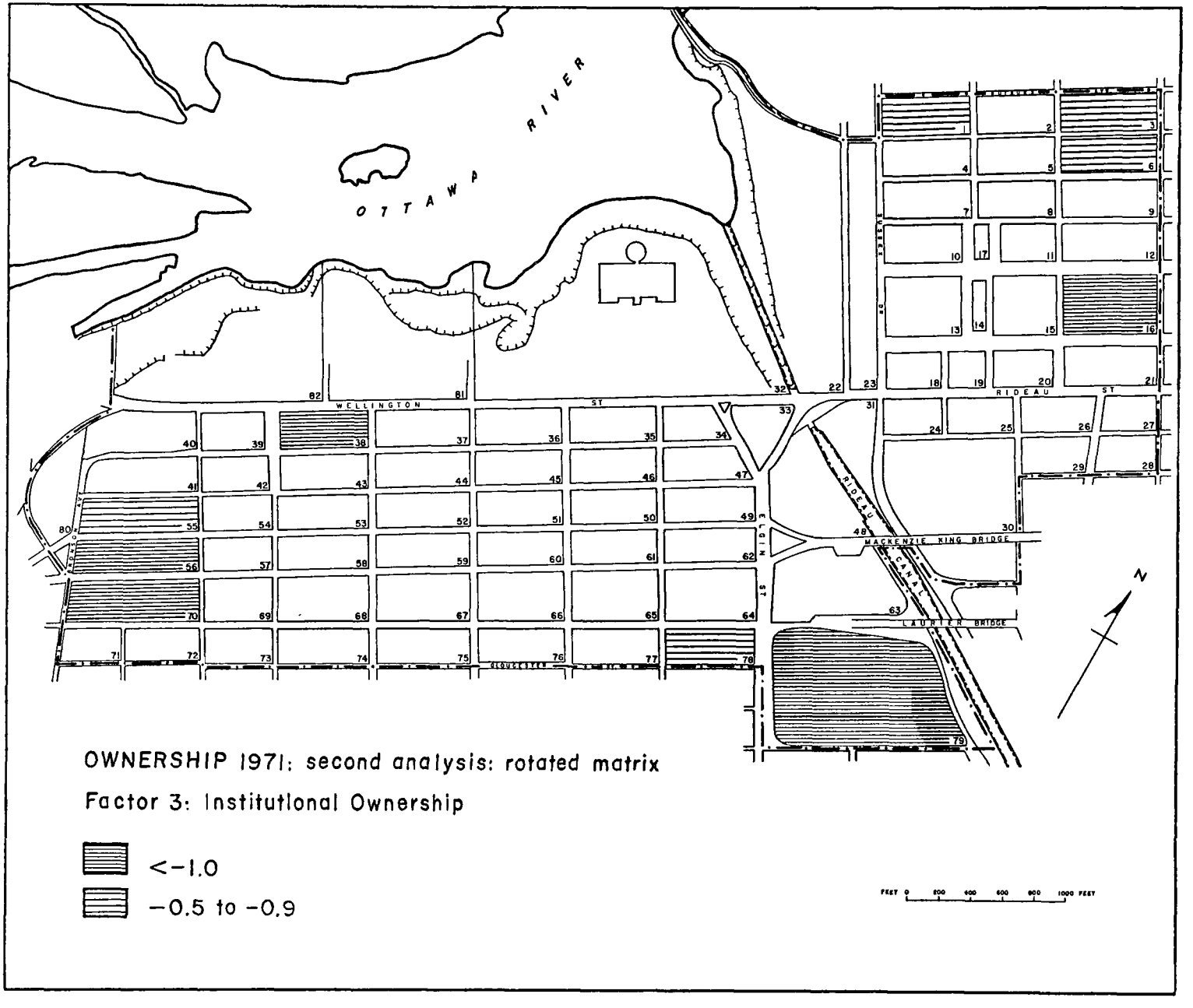
[1] Maps for factor 1 (High Value Federal Ownership) and factor 6 (High Value Private Ownership) have been excluded because they are identical to those for the corresponding factors in the first analysis (maps 11 and 16).

[2] Ottawa Citizen, March 6, 1973.


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
ELGIN ST
OTTAWA ST
GLOUCESTER
RIDEAU
MACKENZIE KING BRIDGE
CANAL
LAURIER BRIDGE
N
OWNERSHIP 1971: second analysis: rotated matrix
Factor 2: Block Fragmentation
>1.0
0.5 to 0.9
FEET 0 200 400 600 800 1000 FEET

MAP 19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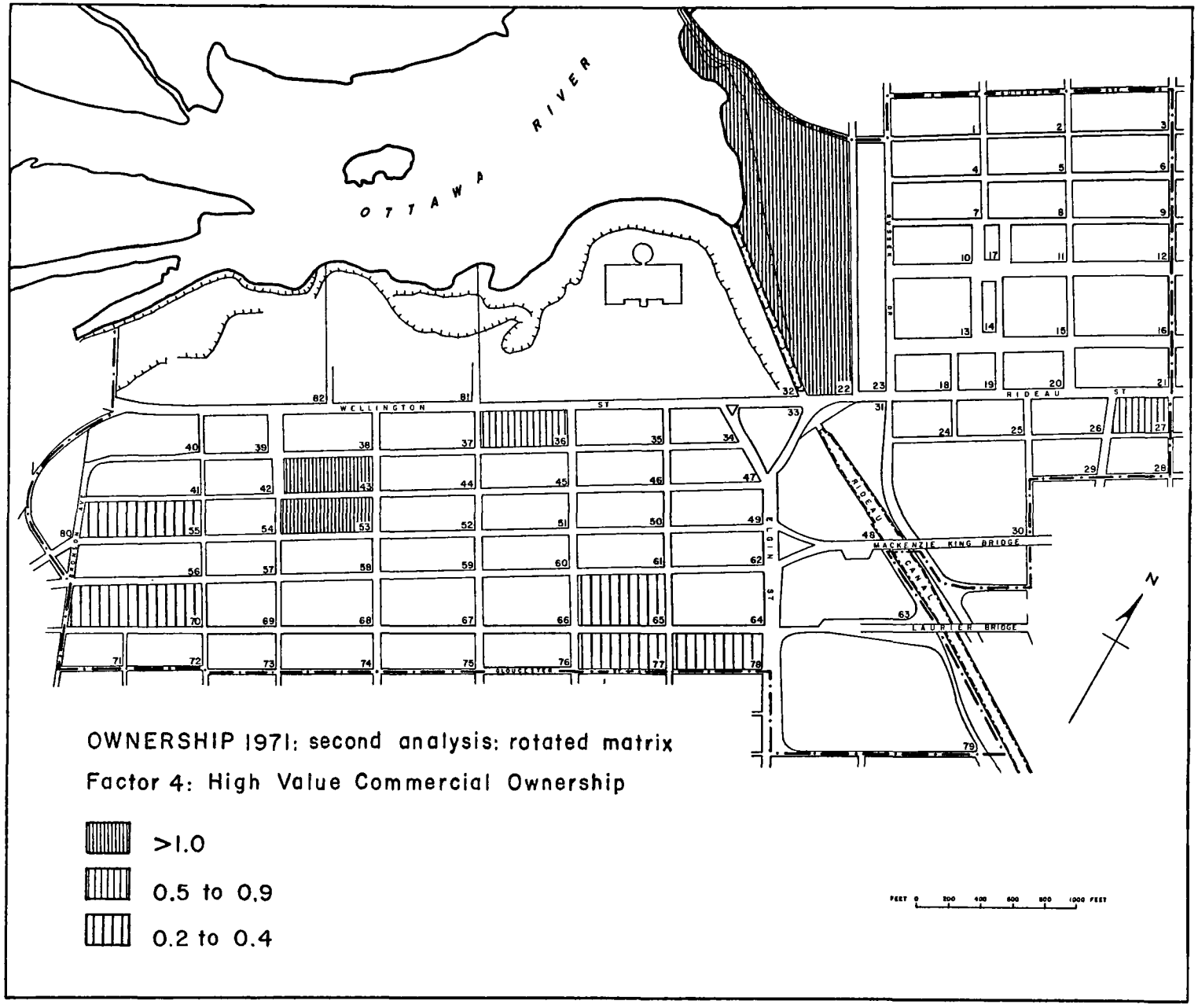
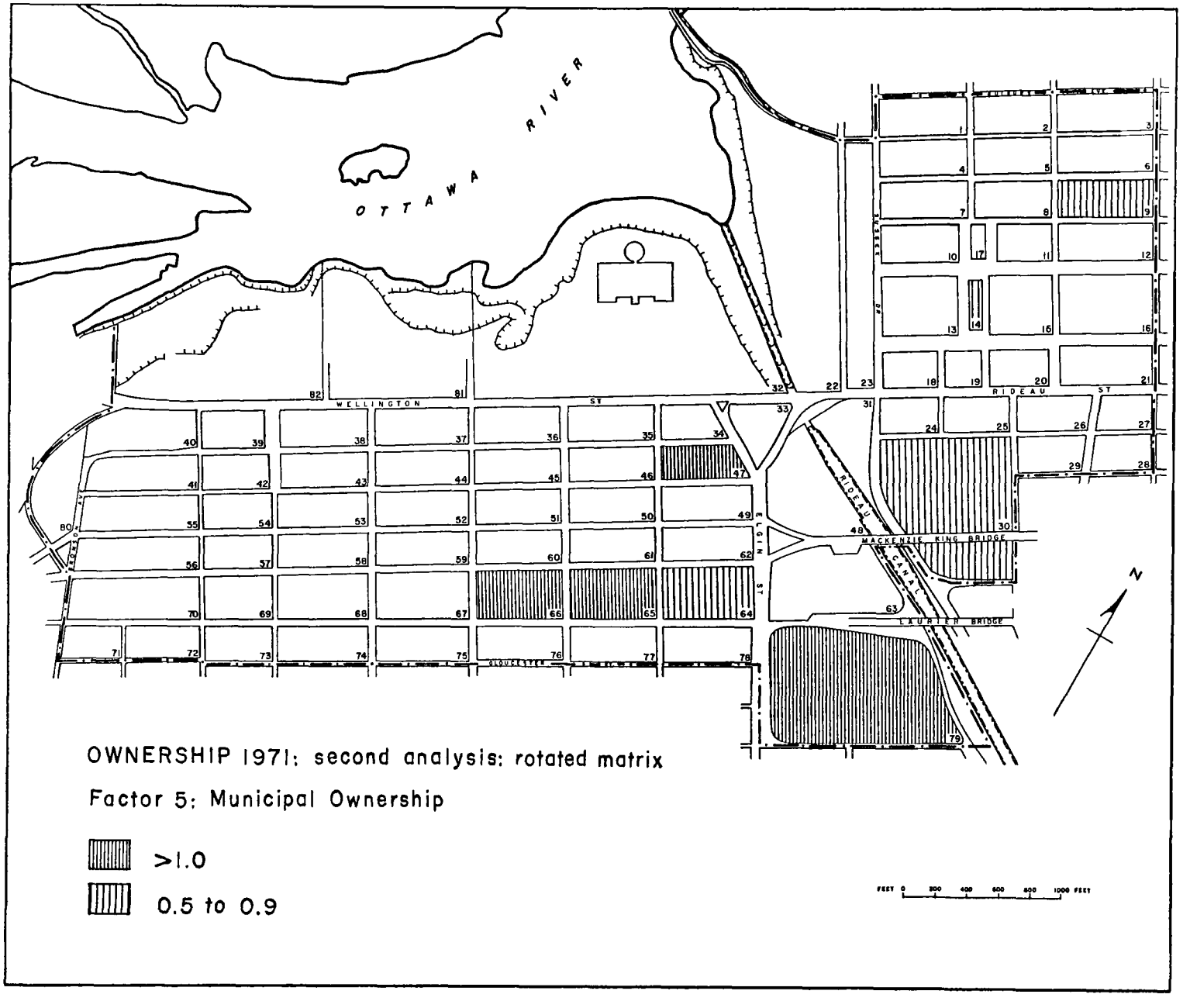
CANAL
LAURIER BRIDGE
ELGIN ST
QUEEN ST
RIDEAU
N
OWNERSHIP 1971: second analysis: rotated matrix
Factor 3: Institutional Ownership
<-1.0
-0.5 to -0.9
FEET 0 200 400 600 800 1000 FEET

MAP 20


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
CANAL
OWNERSHIP 1971: second analysis: rotated matrix
Factor 4: High Value Commercial Ownership
>1.0
0.5 to 0.9
0.2 to 0.4
N

MAP 21


OTTAWA RIVER
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GLOUCESTER
RIDEAU CANAL
MACKENZIE KING BRIDGE
LAURIER BRIDGE
OWNERSHIP 1971: second analysis: rotated matrix
Factor 5: Municipal Ownership
>1.0
0.5 to 0.9
FEET 0 200 400 600 800 1000 FEET

MAP 22

4.2. Spatial Patterns of Land Ownership

The shape and size of blocks, the lot distribution within them, was dictated by early lot surveys. Similarly, an important part of land ownership within the central area is the result of historical decisions. Such is the case for large federal holdings along the Ottawa River and along the Rideau Canal. The federal government is expanding its ownership along Wellington street, however. It announced in March 1971[1] the expropriation of three blocks along Wellington street (blocks 34, 35, 36) south of Parliament Hill. All properties had been acquired by 1975 with the exception of the American Embassy (block 35). As stated by the government, the purpose of the expropriation was "to protect the environment of Parliament from any development which could adversely affect it and also to provide land for an appropriate expansion of parliamentary facilities or other government requirements."[2] The government also owns smaller properties in the central area but more specifically along Sussex Drive. The purpose of acquiring properties in Lower Town is to restore and preserve the historical character of that portion of the central area.

High value properties, and therefore medium sized as compared to large federal lands, are found in Upper Town. These properties can be associated either with private or commercial ownership. Although no specific distributional pattern can be discerned, other than that

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[1] Ottawa Journal, March 23, 1971.
[2] Ottawa Journal, September 18, 1974.

mentioned above, the recent developments of blocks 43 and 53 attest to a new nucleus within the downtown, west of the traditional Wellington and Sparks high value area.

Medium sized properties can also characterize municipal and institutional ownerships. The spatial pattern of municipal ownership is also difficult to define. With the exception of blocks 14 and 17, the market square, and block 47, municipal properties appear to occupy marginal or non-strategic positions in the area under study. Institutional ownership manifests a distinct peripheral distribution, however, both in the Lower Town and Upper Town areas. The distribution of churches testifies to the historical presence of residential communities whose importance and character has altered significantly. The Upper Town residential character has undergone more drastic changes than the Lower Town area. This can perhaps be best verified by the occupancy factor, from the first analysis, which individualizes most clearly the northeastern section of Lower Town.

These peripheral areas, and more precisely the northeastern and the westernmost sections, are characterized by both private ownership and strong block fragmentation. Block framentation indicates that lots have undergone a minimum of consolidation. This is more amply verified for the northeastern section in the second analysis (factor 2: Block Fragmentation). Map 19 also shows that at least four blocks in the central portion of the area west of the canal exhibit similar characteristics.

4.3. Evolutionary Trends of Land Ownership

Two major trends can be observed for the Ottawa central area. The first concerns increasing lot consolidation and the second is the growing importance of federal and commercial ownerships. Lot consolidation, or the emergence of large properties, is closely related to both types of ownership. The obvious constraint is the enormous capital necessary for the reconstruction and development of central areas. The full block development of both blocks 43 and 53 is an early manifestation of this type of massive development. A few examples of recent acquisitions and proposed construction plans will elucidate these trends for the first part of the 1970 decade.

The expropriation by the federal government of three blocks south of Parliament Hill has already been noted. Federal acquisition of block 44, although prior to this expropriation, is nevertheless recent. These large land acquisitions will have repercussions in the downtown area. Metropolitan Life for example, has purchased a 48,000 square foot lot (8 surveyed lots) in block 51 to rebuild its headquarters previously located in block 36.[1] The Ottawa Journal bought half of block 67; forced to move from block 44, it also needed to modernize its facilities and thus chose to remain in the central area.[2]

Entire blocks have also been purchased by commercial interests;

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[1] Ottawa Citizen, July 31, 1973.

[2] Ottawa Journal, August 3, 1971. The Ottawa Citizen, on the other hand, chose a new suburban location (from block 46): Ottawa Citizen, July 29, 1972.

such is the case for blocks 58,[1] 72 and 76. A twin tower apartment complex is planned for block 72, an older residential block.[2] A twin towered office commercial project is already under construction in block 76.[3] A more complex development, Canada Centre, which is to include several multipurpose constructions, is planned for block 50 and half of block 46.[4] The Centre Town project has been proposed on city owned property which now occupies more than half block 66.[5] A much larger project has been proposed for the redevelopment of Lower Town. The first phase is to involve a complete transformation of an 8.8 acre area which includes blocks 24, 25 and 30. The interesting aspect of this large scale proposal is the involvement and cooperation of the federal government, the municipal government and several commercial agencies.[6]

Institutional ownership has evolved very little due to the historical and architectural value of buildings on institutional lands. Included in this category are the several central area churches located in blocks 1, 37, 41, 77 and 78. Block 27 was owned by a religious order for more than one hundred years; historical considerations were waved when an old structure on that site was bought and demolished in the early 1970's by a development firm.

Lot consolidation and the evolution of ownership is nevertheless a slow process. The current trends are only a part and a reflection of

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[1] Ottawa Citizen, March 10, 1973.
[2] Ottawa Citizen, July 16, 1973.
[3] Ottawa Citizen, March 10, 1973.
[4] Ottawa Citizen, March 10, 1973.
[5] Ottawa Journal, May 30, 1974.
[6] Ottawa Journal, May 1, 1974.

an enthusiastic effort to revitalize the central area during the past decade.

CHAPTER V

LAND USE WITHIN THE CENTRAL AREA: A CROSS-SECTIONAL ANALYSIS

5.1. Structural Analysis

5.1.1. Building Stock: 1961

Building stock is an important differentiating element within the urban context and most specifically within the central area of the city. Building stock, or building structure, can be operationally defined in terms of several variables: number of buildings, floors above and below ground level, total floor space and block coverage. The variable 'floor space below ground level' is included within the data set in an attempt to distinguish the growing importance of this space in modern construction.

The building stock analysis for 1961 distinguishes two factors which account for 90 percent of the total variance (table 7). The first factor establishes a relationship between the 'number of buildings' and 'floors above and below ground level'. This relationship, clearly defined in the correlation matrix, (table 8) suggests a density of construction. The spatial distribution of factor scores, indicated on map 23 , is noticeably peripheral, distinguishing blocks where the number of buildings is highest.

The second factor, on the other hand, suggests an Intensity of Occupation as measured by 'floor space' and 'block coverage'. Larger

TABLE 7

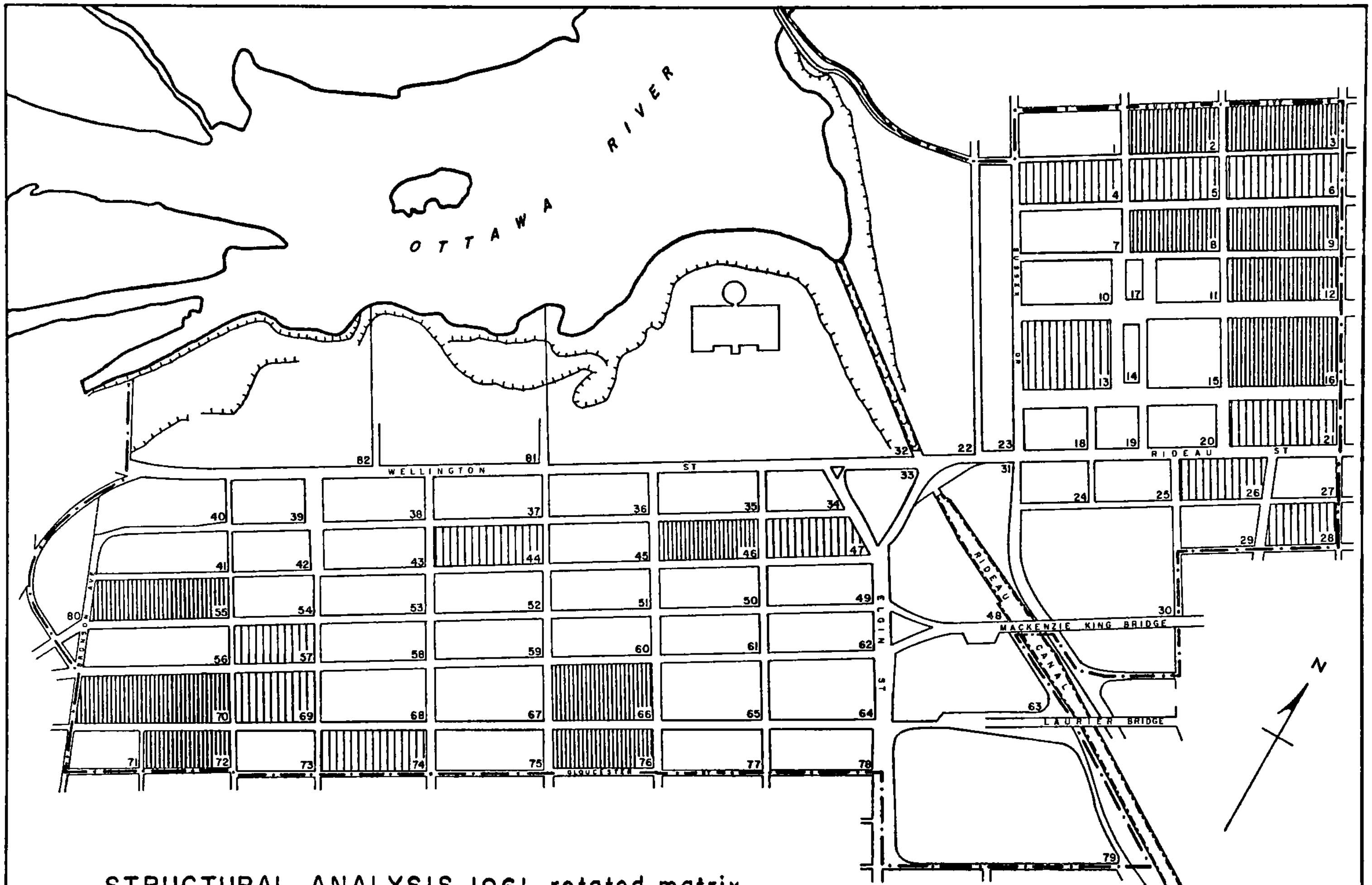
STRUCTURAL ANALYSIS 1961:
CORRELATION MATRIX

Factor Number			1	2
Eigenvalue			2.8	1.8
Percent of Total Variance			53.0	37.5
Variable		Communality	Density of Construction	Intensity of Occupation
24.	No. of Buildings	.93	.957	
25.	Storeys Below Ground	.96	.976	
26.	Storeys Above Ground	.82	.881	
27.	Tot. Floor Space	.91		.955
28.	Lot Coverage	.88		.940

TABLE 8

STRUCTURAL ANALYSIS 1961:
CORRELATION MATRIX

		24	25	26	27	28
24.	No. of Buildings	1.00				
25.	Storeys Below Ground	.96	1.00			
26.	Storeys Above Ground	.72	.77	1.00		
27.	Tot. Floor Space				1.00	
28.	Lot Coverage				.80	1.00



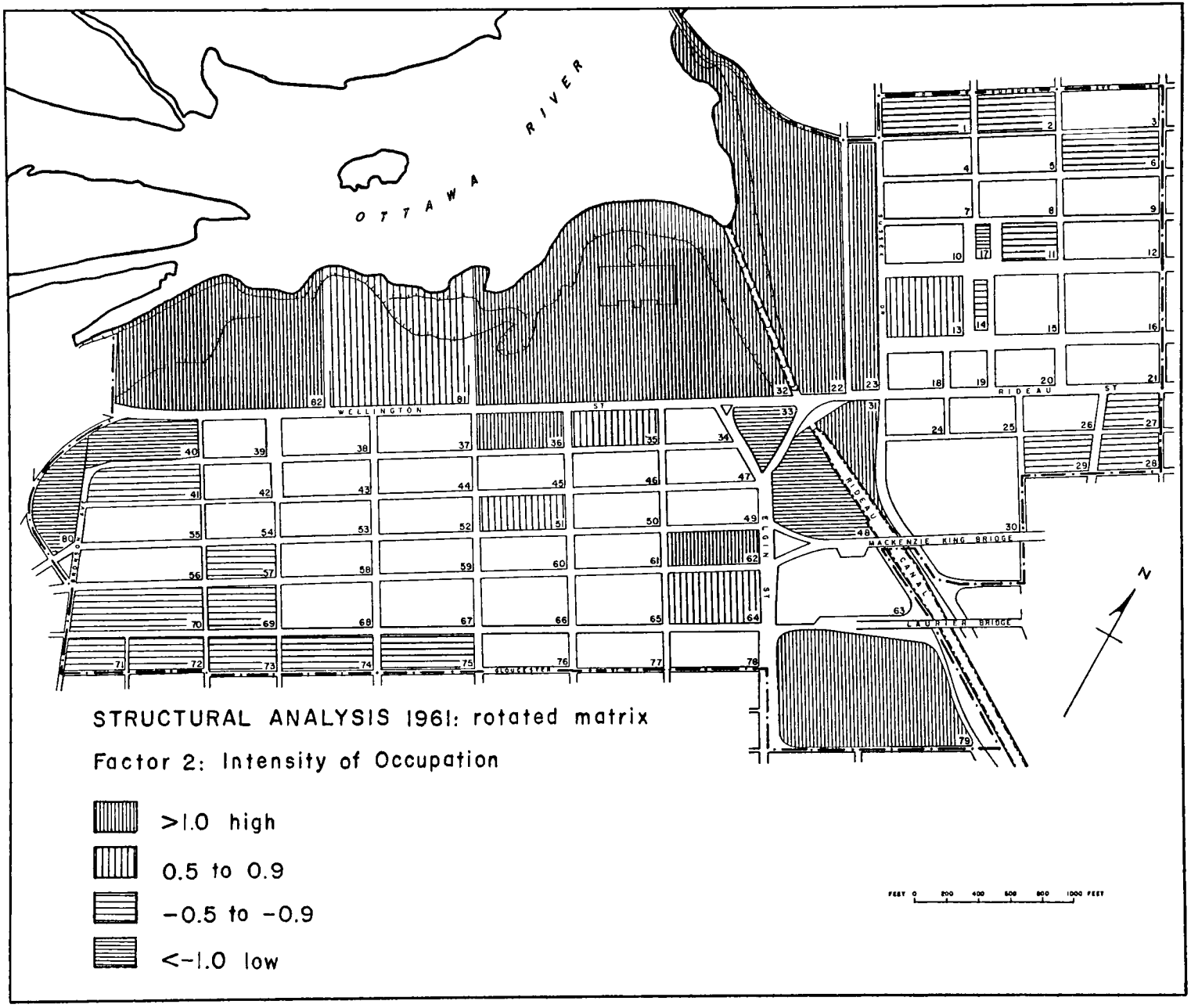
STRUCTURAL ANALYSIS 1961: rotated matrix

Factor I: Density of Construction

>1.0

0.5 to 0.9

MAP 23


OTTAWA RIVER
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GLOUCESTER
MACKENZIE KING BRIDGE
CANAL
LAURIER BRIDGE
STRUCTURAL ANALYSIS 1961: rotated matrix
Factor 2: Intensity of Occupation
>1.0 high
0.5 to 0.9
-0.5 to -0.9
<-1.0 low
FEET 0 200 400 600 800 1000 FEET

MAP 24

spatial units score highly on this component as well as a few regularly sized blocks in the Upper Town area. The negative factor scores were also mapped in order to distinguish those blocks characterized by a low Intensity of Occupation (map 24). Spatial units scoring -1.0 are devoid of construction. The distribution of scores between -0.5 to -0.9 confirms that the lowest Intensity of Occupation occurs along the margins of the study area. Half of these scores also comprise one third of the blocks appearing on the Density of Occupation map 23 indicating a certain, although inconclusive, relationship between low Intensity of Occupation and Density of Building Stock as defined by the variables.

5.1.2. Building Stock: 1971

The rotated matrix for the 1971 structural analysis defines the same two factors outlined for 1961. The percent of the variance accounted for by the factors is reduced to 82 however. A comparison of tables 7 and 9 shows that the strength of the Intensity of Occupation factor, as measured by the percent of total variance figure, is slightly increased, whereas the strength of the Density of Occupation factor is reduced. The explanation for this change appears to be rooted in the 'storeys above ground level' variable. This variable retains a significant weight on both factors in 1971. In the correlation matrix, (table 10), its association with 'number of buildings' is reduced from .72 in 1961 to .34 in 1971; its correlation with 'total floor space', on the other hand, increases considerably from .17 to .67 in 1971, indicating a major shift in the building structure during the decade.

Close attention to blocks scoring significantly on the density

TABLE 9

STRUCTURAL ANALYSIS 1971:
ROTATED FACTOR MATRIX

Factor Number			1	2
Eigenvalue			2.1	1.9
Percent of Total Variance			42.5	39.6
Variable		Communality	Density of Construction	Intensity of Occupation
29.	No. of Buildings	.82	.899	
30.	Storeys Below Ground	.93	.958	
31.	Storeys Above Ground	.80	.628	.640
32.	Tot. Floor Space	.90		.952
22.	Lot Coverage	.63		.794

TABLE 10

STRUCTURAL ANALYSIS 1971:
CORRELATION MATRIX

		29	30	31	32	22
29.	No. of Buildings	1.00				
30.	Storeys Below Ground	.78	1.00			
31.	Storeys Above Ground	.34	.67	1.00		
32.	Tot. Floor Space			.67	1.00	
22.	Lot Coverage				.61	1.00

component indicates the complexity of the component for 1971. The number of buildings per block has decreased, due to demolition, for eight of the ten blocks appearing on map 25 but not figuring on the corresponding map for 1961. Six of these ten blocks have seen their number of floors above ground level increase, however, in some instances considerably. The following table provides the original data for these blocks.

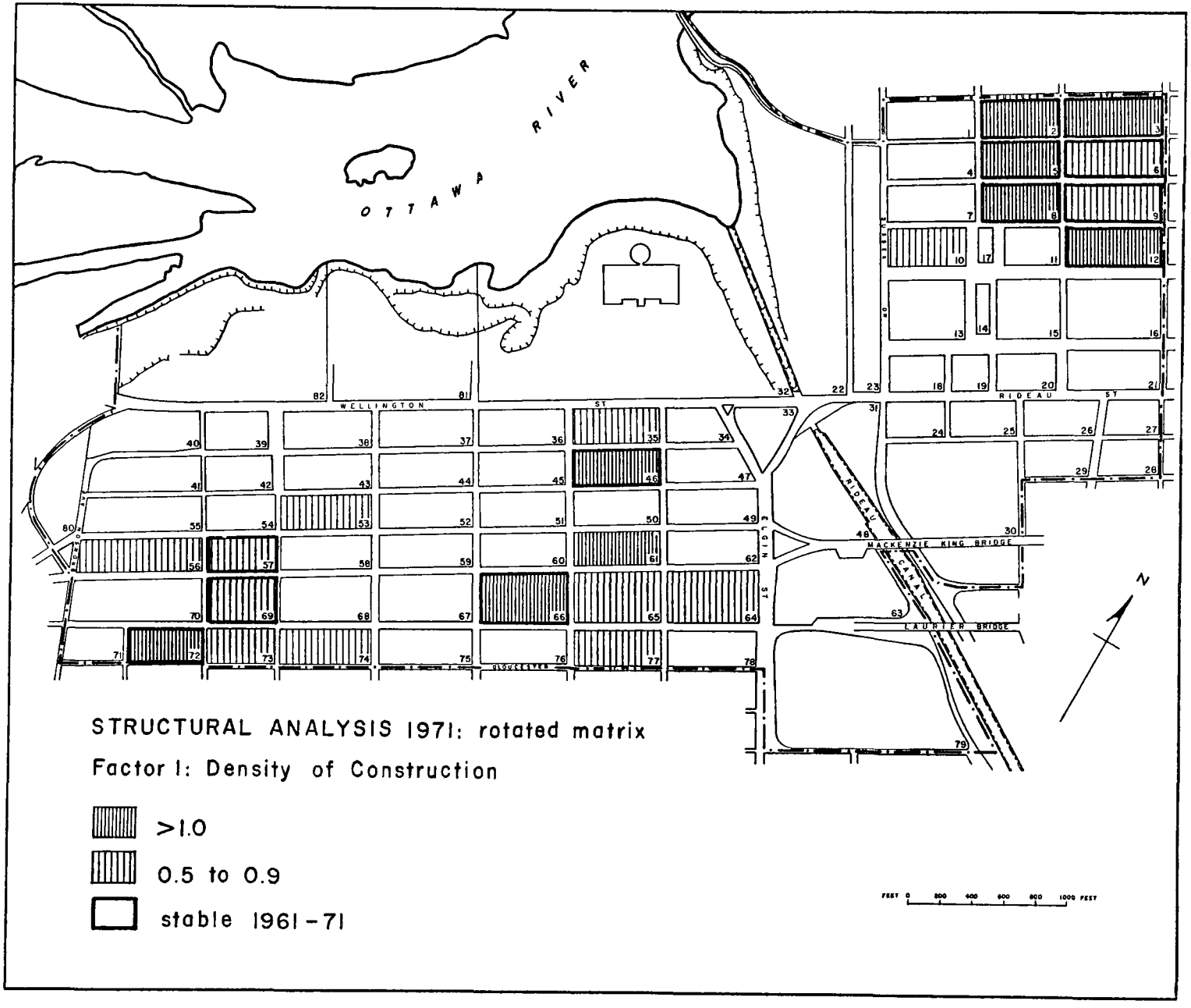
TABLE 11

BUILDING STOCK DATA FOR SELECTED BLOCKS *

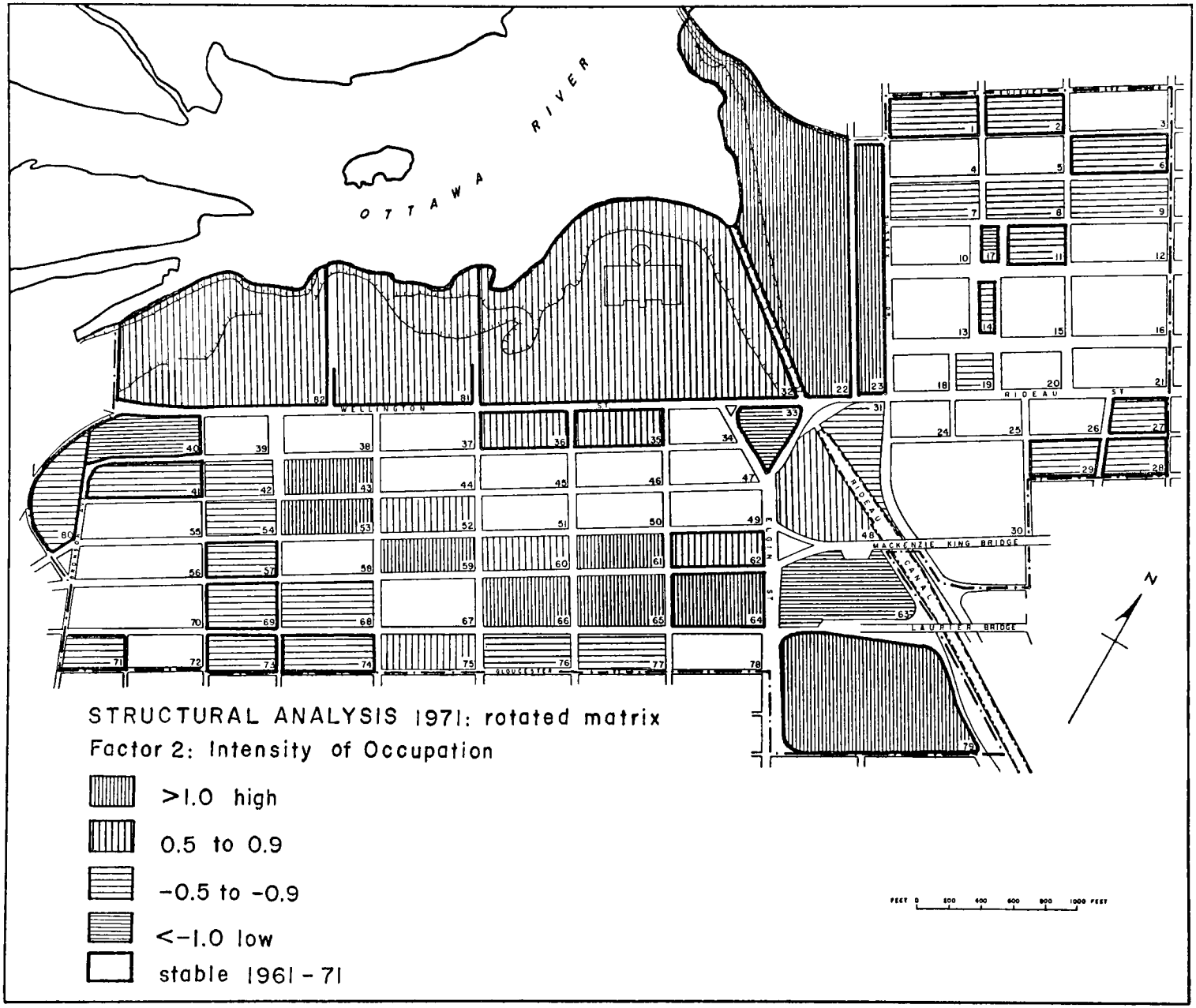
Block	Number of Buildings		Storeys below Ground Level	Storeys above Ground Level	
	1961	1971	1971	1961	1971
10	15	14 - **	13	30	28 -
35	14	12 -	13	32	54 +
53	11	3 -	17	3	68 +
56	13	13	13	20	20
61	9	7 -	20	25	78 +
64	13	9 -	15	30	68 +
65	14	11 -	14	37	67 +
73	13	14 +	14	18	24 +
74	17	13 -	14	21	27 +
77	16	13 -	12	22	19 -

* The selected blocks are those which appear on the Density of Occupation map for 1971 but do not figure on the Density of Occupation map for 1961.

** Plus or minus signs indicate either an increase or a decrease between 1961-1971.


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
RIDEAU
MACKENZIE KING BRIDGE
CANAL
LAURIER BRIDGE
GLOUCESTER
N
FEET 0 200 400 600 800 1000 FEET
STRUCTURAL ANALYSIS 1971: rotated matrix
Factor 1: Density of Construction
>1.0
0.5 to 0.9
stable 1961-71

MAP 25


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
CANAL
N
STRUCTURAL ANALYSIS 1971: rotated matrix
Factor 2: Intensity of Occupation
>1.0 high
0.5 to 0.9
-0.5 to -0.9
<-1.0 low
stable 1961 - 71
FEET 0 200 400 600 800 1000 FEET

MAP 26

It is therefore not surprising that some of these blocks also figure on the Intensity of Occupation map for 1971 (map 26).

Blocks which attain the significant 0.5 factor score level, both for 1961 and 1971, are considered stable in terms of the density relationship expressed by the component. All these blocks have seen their 'total number of buildings' reduced during the decade with the exception of block 5 which has retained the same number of buildings. Correspondingly, the 'number of storeys above ground level' has decreased with the exception of blocks 46, 66 and 69 for which gains are not important. The stability here expressed does not imply that the building stock has remained constant for the two analyses, but only that the relationship expressed by the component remains valid.

The variable 'storeys below ground level' nevertheless achieves the highest loading on this component. For stable blocks this value is generally equal to, or less than, the number of buildings in the block. Exceptions are blocks 46 and 66 in the central portion of the study area. These values are high since the number of buildings on these blocks remains high in 1971. The loading of this variable on the factor also explains the new addition of blocks 35, 53, 61, 64 and 65 on the density map for 1971. The number of storeys below ground level often far exceeds the number of buildings for the block. These blocks are further characterized by their Intensity of Occupation as indicated by the second factor. The anticipated importance of underground floor space, although not specified by the factor structure, is nevertheless revealed in the cartographic distribution of factor scores. This appears to be one of the most significant evolutionary trends for

1961-71 decade.

The maximization of space by means of underground construction in an attempt to come to grips with the parking problem within the central area. But an increasing quantity of underground floor space is used for retail purposes. The first storey below ground level for blocks 43 and 53 accommodates a large climate controlled shopping mall which includes approximately 37 boutiques offering an enormous variety of goods and services. A new structure, proposed by St. Andrew's Presbyterian Church (block 38), plans two below-ground retail shop levels; a third level is to accommodate community activities.[1]

The development of underground space is more closely associated with intensive use of the land, however. Map 26 reveals that there has been a dramatic change in the Intensity of Occupation during the 1961-71 decade. Ten blocks are added to the 1971 map and only 3 blocks, from a total of 13 characterized by Intensive Occupation in 1961, are dropped. These 10 blocks have increased their floor space considerably. Table 12, Storeys above Ground Level for Selected Blocks, verifies the importance of new constructions for these spatial units. Intensity of Occupation further appears to be a definite characteristic of Upper Town where more than 90 percent of new construction has occurred during the decade.

Approximately 5,500,000 square feet of private office space have been added to the central area between 1960 and 1970. Ninety-four percent of this new construction occurred since 1964 and the

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[1]Ottawa Citizen, Oct. 17, 1974

TABLE 12

STOREYS ABOVE GROUND LEVEL FOR SELECTED BLOCKS *

Block	Storeys above Ground Level	
	1961	1971
43	16	59
48	0	3
52	16	25
53	3	68
59	22	47
60	23	33
61	25	78
65	37	67
66	39	43
75	12	29

* The selected blocks are those which appear on the Intensity of Occupation map for 1971 but do not figure on the Intensity of Occupation map for 1961.

construction boom has not yet waned. The greatest contributing factor to floor space expansion has been the increased leasing of office space by the federal government (L'étude de la zone centrale, 1969). Prior to 1960, the federal government was located primarily in government owned space. Federal authorities leased between 20 and 25 percent of the office space in new buildings which were then being developed. Since 1960, in response to growing space demand, the trend has been for the government to develop less space of its own and to lease more space

on the private market. Approximately 60 to 70 percent of the new office space developed in central Ottawa has been leased by government activities (Downtown Demand Study, 1969). In 1968 the government occupied 58 percent of 6,567,000 square feet of office space owned by private enterprise.

Rapid development has not only increased the volume of office space, but it has also radically altered its quality in the central area. Modern and large complexes house more than a third of the total office space during the early seventies. Therefore, concomitant with the increasing size of properties previously discussed, is the increasing dimension of the developments. This boom in construction has altered the skyline and the character of the central area but has also modified its influence as a major source of office space for the metropolitan region as a whole.

For the city of Ottawa, not the least of influences to be added to the economic considerations pertinent to central area development, is height control. The history of building height studies goes back to 1914 when legislation to restrict the height of buildings was passed by the city in order to protect Parliament Hill as a focal point of the central area. Until 1963 all buildings in the city were restricted to a height of 110 feet from grade. By-law AZ-64 restricted the height of buildings in the central part of the city to 150 feet above grade. This largely explains why 1964 is an historic date for high-rise construction in the central area. Following further review, design became the prime consideration with respect to development surrounding the Parliament Buildings. For this reason By-law 83-67 was passed

reducing the area of height control from the central part of the city to the central area.[1] In May 1968, the Ottawa City Council further reduced the core area, thus removing much of downtown Ottawa from previous height by-law restrictions. The newly designated core area is bounded by Wellington Street on the north, Elgin on the east, a westerly point just beyond Bank Street, and Albert Street to the south (Downtown Demand Study, 1969). This amendment both freed a number of previously proposed major high-rise developments in downtown Ottawa and brought forth numerous new applications for high-rise buildings.

Height control has become more flexible for two major reasons. Firstly a system of building heights, based on sight planes emanating from selected view points have been established permitting a discrimination of heights between blocks. A new height control, regulated according to feet above sea level, was proposed to replace the 150 foot limit. The areas that lie outside the angular plane control sectors have a proposed maximum height of 577 feet above sea level, this height being consistent with the top of the Peace Tower. In 1970, several new buildings located in blocks 43, 53, 59, 61 and 64 exceeded the 150 feet limit.[2] Secondly, floor space or building height may be increased, commensurate with zoning density if arcades,

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[1] The central area here defined coincides with the boundaries of the study area.

[2] Map 41 shows buildings constructed between 1960-1970.

terraces or pedestrian walkways are incorporated within the building design. With these new considerations, the floor space index, obtained from zoning densities, has become the most important economic variable.

5.2. Land Use within the Central Area: First Analysis

5.2.1. Choice of Data

The definition and content of variables for the 1961-71 floor space analysis was conditioned by the availability of data for 1961. This condition explains grouped variables such as 'utilities and public services', 'wholesale and warehousing', and 'retail, services and repair'. Services in this instance includes such outlets as dry cleaners and beauty salons. Professional services are grouped with the variable 'other office'. 'Wholesale and warehousing' is not strictly comparable for both sample years. For 1961, this variable considers storage areas associated with retail outlets; this explains to some extent its weak correlation with 'retail, services and repair' (.33). For 1971, such detailed information concerning storage space is not available. The variable 'other unclassified' includes miscellaneous land uses from vacant floor space to heating plants for government buildings.

Institutional floor space includes churches, rectories, schools as well as the public library and the National Arts Gallery located in blocks 65 and 62 respectively. The National Library in block 82 was included within government floor space because of the national scope of its activities and the labour force involved, totalled at approximately

550 people.

Government floor space includes municipal, provincial and federal activities. Municipal and provincial functions occupy but a very small fraction of the total government floor space so that the variable is considered, throughout the study, as an expression of federal government activities.

The only non floor space data available for 1961 is parking; the cross-sectional analysis therefore ignores 'parks' and 'vacant space'. Similarly, the analysis considers population data for both 1961 and 1971; employment statistics however were only available for 1971.

Although floor space data provides more detailed information than gross land use data, the analysis would remain incomplete without the inclusion of structural variables as previously defined.

5.2.2. Floor Space Analysis: 1961

For 1961, 9 factors are needed to explain 80 percent of the total variance for the 22 variables included in the analysis. The correlation matrix reveals that 65 percent of the noted correlations (table 13) are related to structural data although they comprise only 22 percent of the variables; this percentage increases to 76 percent when the .30 correlations are eliminated from consideration.

The first factor associates residential land use to density of construction as previously defined in the building stock analysis. The two following factors emphasize the intensity of land use as specified by the variable 'total floor space'; the second component associates Intensity of Occupation with government office space, whereas the third

TABLE 13

FLOOR SPACE ANALYSIS 1961:
CORRELATION MATRIX

		24	25	26	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	27	28	48	49
24.	Tot. No. of Buildings	1.00																					
25.	Storeys Below Ground	.96	1.00																				
26.	Storeys Above Ground	.72	.77	1.00																			
33.	Residential	.77	.74	.46	1.00																		
34.	Residential Commercial					1.00																	
35.	Government		-.30				1.00																
36.	Finance							1.00															
37.	Diplomatic								1.00														
38.	Other Office			.33		.39				1.00													
39.	Ret. Serv. and Repair										1.00												
40.	Auto. Sales and Serv.											1.00											
41.	Rest. and Entert.					.76				.43			1.00										
42.	Whole. and Warehousing										.33			1.00									
43.	Manufacturing														1.00								
44.	Utilit. and Publ. Serv.															1.00							
45.	Other Unclass.						.39										1.00						
46.	Open Parking													.35				1.00					
47.	Enclosed Parking														.35		.31		1.00				
27.	Tot. Floor Space					.38	.78			.33			.55							1.00			
28.	Block Coverage						.74						.31				.37			.80	1.00		
48.	Population	.77	.74	.47	.96																	1.00	
49.	Institutional														.47								1.00

component relates intensity with hotels entertainment and general office space. Together, these three factors account for 41 percent of the total variance (table 14).

The six following factors, on the other hand, account for only 39 percent of the variance. Factors 4, 5 and 6 reveal various land use associations. 'Wholesale and warehousing' for example is associated with 'retail and services' and 'floor space: finance' in the fifth factor, and with 'open and enclosed parking' in factor six. The first association is due, in part, to the definition of the 'wholesale and warehousing' variable which includes retail storage space for 1961. The association with 'open parking' (verified by the correlation matrix) may be more closely related to non-intensive land uses within the study area.

The last three components, factor 7, Automotive Sales and Services, factor 8, Diplomatic Functions, and factor 9, Utilities and Public Services, are each essentially defined by a single variable. The factor structure therefore emphasizes the minor role played by these activities within the central area and their haphasard occurrence in relation to the other types of land uses studied. The correlation matrix further shows that these three variables, from which the factor names are derived, exhibit no significant correlations with any of the variables included in the analysis.

5.2.3. Floor Space Analysis: 1971

For 1971, eight factors are specified; these components account for 74 percent of the variance among the variables as opposed to 80

TABLE 14

FLOOR SPACE ANALYSIS 1961: FIRST ANALYSIS:
ROTATED FACTOR MATRIX

Factor Number		1	2	3	4	5	6	7	8	9
Eigenvalue		4.0	2.8	2.2	1.6	1.6	1.6	1.2	1.2	1.1
Percent of Total Variance		18.3	12.9	10.3	7.6	7.4	7.3	5.8	5.6	5.0
Variable	Communality	Residential Land Use	Government Office Space	Tertiary Activities	Institu. and Manuf. Activities	Retail Function	Parking	Auto. Sales and Services	Diplomatic Functions	Utilities and Public Services
24. Tot. No. of Buildings	.94	.957								
25. Storeys Below Ground	.93	.954								
26. Storeys Above Ground	.90	.789							.379	
33. Residential	.92	.861								
34. Residential Commercial	.89			.925						
35. Government	.90		.908							
36. Finance	.50					-.637				
37. Diplomatic	.80								.891	
38. Other Office	.71			.578				.351	.419	
39. Ret. Serv. and Repair	.59					-.547				
40. Auto. Sales and Serv.	.80					-.747		.873		
41. Rest. and Entert.	.89			.876						
42. Whole. and Warehousing	.73						.552			
43. Manufacturing	.84				.867	-.582				
44. Utilit. and Publ. Serv.	.88									.927
45. Other Unclass.	.57		.605							
46. Open Parking	.62						.750			
47. Enclosed Parking	.66		.315				.588			
27. Tot. Floor Space	.96		.821	.436						
28. Block Coverage	.92		.870							
48. Population	.92	.863								.302
49. Institutional	.79				.811		-.321			

percent in 1961. The role of structural variables remains important, however, as 70 percent of the correlations at the .40 level and above are related to these variables (tables 15 and 16).

The general factor structure appears to have changed significantly; residential land use, factor 2, is the only component which remains stable for the two analyses. Variables such as 'block coverage' and 'unclassified floor space', related to government land use in 1961, are now associated with 'open parking' (factor 4). This underlines the growing importance of parking on blocks for which coverage is significant; the relationship emphasizes large blocks which, as previously indicated are generally, though not exclusively, federal properties.

The variable 'wholesale and warehousing' is associated in 1971 with the hotel function and to some degree with 'total floor space' (.34) as indicated in factor 5. This change in land use association may be largely due to the inconsistency in the variable definition for the two analyses but it may also show the inadequacy of combining wholesale and warehousing activities. Wholesale outlets for specific goods may require a central location; the sale of office supplies, equipment and furnishings are pertinent examples. For such dealers, office space with limited showroom facilities may be found in the central area with warehousing facilities located in the suburbs. The consideration of the activities as a single variable supposes that they behave in a similar way; more detailed floor space information would permit a verification of this assumption.

The last factor opposes 'auto sales and services' to 'insti-

TABLE 15

FLOOR SPACE ANALYSIS 1971:
CORRELATION MATRIX

		29	30	31	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	32	22	65	66
29.	Tot. No. of Buildings	1.00																					
30.	Storeys Below Ground	.78	1.00																				
31.	Storeys Above Ground	.34	.67	1.00																			
50.	Residential	.41	.37		1.00																		
51.	Residential Commercial			.30		1.00																	
52.	Government			.46			1.00																
53.	Finance			.44				1.00															
54.	Diplomatic	.31						.36	1.00														
55.	Other Office			.48				.43		1.00													
56.	Ret. Serv. and Repair										1.00												
57.	Auto. Sales and Serv.											1.00											
58.	Rest. and Entert.												1.00										
59.	Whole. and Warehousing					.54								1.00									
60.	Manufacturing			.57				.60	.39	.52					1.00								
61.	Utilit. and Publ. Serv.															1.00							
62.	Other Unclass.																1.00						
63.	Open Parking						.42										.41	1.00					
64.	Enclosed Parking			.35		.31	.33						.46						1.00				
32.	Tot. Floor Space			.67		.58	.75			.40					.40		.32		.43	1.00			
22.	Block Coverage						.56										.50	.57		.61	1.00		
65.	Population	.56	.52		.70		-.30													-.31		1.00	
66.	Institutional																						1.00

TABLE 16

FLOOR SPACE ANALYSIS 1971: FIRST ANALYSIS:
ROTATED FACTOR MATRIX

Factor Number		1	2	3	4	5	6	7	8
Eigenvalue		2.9	2.9	2.4	2.2	1.6	1.5	1.2	1.1
Percent of Total Variance		13.5	13.2	10.9	10.3	7.6	7.1	5.9	5.3
Variable	Communality	General Office Space	Residential Land Use	Government Office Space	Extensive Land Uses	Hotel Function	Entertainment	Retail Function	Institutional vs. Auto. Services
29. Tot. No. of Buildings	.86		.856						
30. Storeys Below Ground	.88		.839						
31. Storeys Above Ground	.92	.570	.387	-.637					
50. Residential	.66		.719						
51. Residential Commercial	.81			-.325		.801			
52. Government	.85			-.816	.386				
53. Finance	.65	.792							
54. Diplomatic	.46	.621							
55. Other Office	.56	.692							
56. Ret. Serv. and Repair	.79							.878	
57. Auto. Sales and Serv.	.57								-.665
58. Rest. and Entert.	.86						.915		
59. Whole. and Warehousing	.86					.905			
60. Manufacturing	.74	.832							
61. Utilit. and Publ. Serv.	.45								.505
62. Other Unclass.	.66				.750				
63. Open Parking	.79				.778				
64. Enclosed Parking	.73			-.436			.724		
32. Tot. Floor Space	.92	.331		-.718	.328	.340			
22. Block Coverage	.78			-.388	.755				
65. Population	.83		.829						
66. Institutional	.60				.409				.594

tutional floor space' and 'utilities'. These land uses are characterizedby a low frequency of occurrence within the study area. The residual significance of this factor is further emphasized by their relationship within the correlation matrix; the correlation matrix does not corroborate the association between institutional activities and utilities (.04) nor the opposition between these two variables and 'auto sales and services' (-.08 and -.04 respectively).

5.3. Land Use within the Central Area: Second Analysis

5.3.1. Data Reduction

An examination of the factor structure and a study of the communality of each variable for both analyses indicates the possibility of removing five variables from the floor space study. The first variable to be eliminated is 'wholesale and warehousing' since it is not strictly comparable for the two analyses and also because the assumed relationship which justifies the grouping of these activities may not be verified. The variable 'number of storeys below ground level' is also withdrawn from the data set; it is strongly correlated with 'number of storeys above ground level' and the two variables identify the same relationships in the correlation matrices as well as in the factor matrices.

Three other variables are removed from the second analysis because of the minor role played by these activities in central area definition. The communality for 'automotive sales and services' is reduced from .80 in 1961 to .57 in 1971. This activity characterized by

an extensive use of the land is slowly disappearing from the area under study; in 1961 it occurred in 29 blocks but is found in only 12 blocks in 1971. Only one auto sales establishment was found in the central area in 1971, the Surgenor property located in block 42. This property was rumored for sale during the early seventies; pursuant to the redevelopment of this area, the related auto services activities carried out in adjoining block 54 will be replaced by other land uses. The same phenomenon occurs for the variable grouping 'utilities and public services'; the communality is reduced from .88 to .45 in 1971 and its occurrence from 12 to 4 blocks. Although the communality for 'other unclassified' increases slightly from .57 to .66, it may be assumed that the various land uses that this variable represents do not add to the understanding of land use associations in the central area.

Two variables, diplomatic and financial floor space exhibit low communalities for both analyses, although their role increases slightly in 1971. They are nevertheless retained as independent variables because they provide some insight into the nature of tertiary activities found in the study area.

5.3.2. The Structure of Central Area Land Use: 1961

In the second analysis, the number of factors is reduced to six and the percent variance accounted for by the factors is reduced from 80.6 to 74.7. Since only 5.9 percent of the explanation is lost, it may be assumed that the five variables withdrawn from the analysis did not play a tangible role in explaining floor space associations within the central area. Moreover, the eigenvalue as indicated in table 17 is

TABLE 17

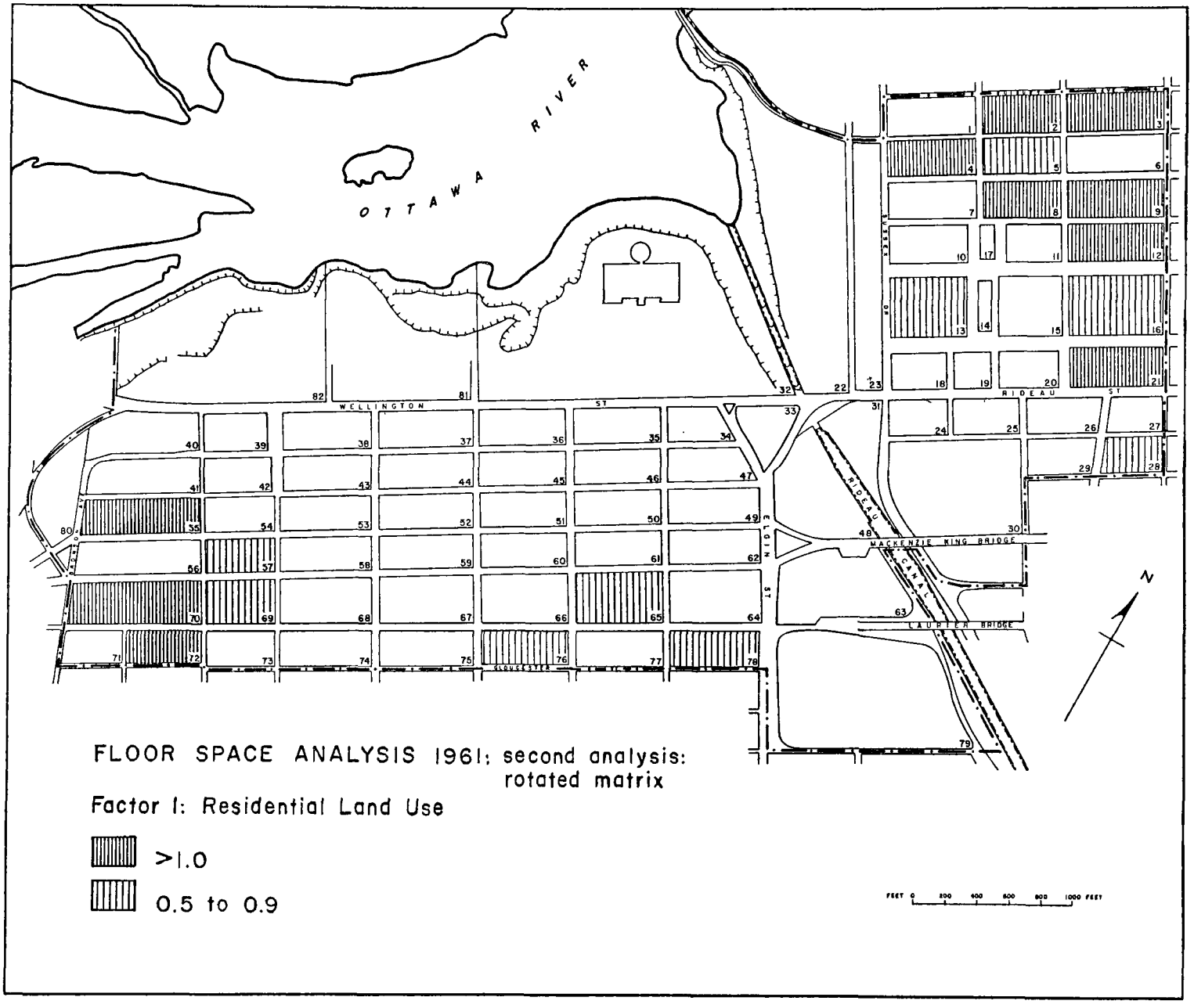
FLOOR SPACE ANALYSIS 1961: SECOND ANALYSIS
ROTATED FACTOR MATRIX

Factor Number		1	2	3	4	5	6
Eigenvalue		3.1	2.6	2.2	1.6	1.6	1.3
Percent of Total Variance		18.5	15.6	13.0	9.7	9.6	8.0
Variable	Communality	Residential Land Use	Government Office Space	Hotel Function	Manuf. and Institutional Activities	Office Space and Retail Activities	Parking Capacity
24. Tot. No. of Buildings	.89	.928					
26. Storeys Above Ground	.90	.755				.481	
33. Residential	.93	.905					
34. Residential Commercial	.89			-.927			
35. Government	.93		-.926				
36. Finance	.42					.589	
37. Diplomatic	.34					.585	
38. Other Office	.60			-.601		.372	
39. Ret. Serv. and Repair	.34					.566	
41. Rest. and Entert.	.86			-.859			
43. Manufacturing	.82				.859		
46. Open Parking	.65						-.780
47. Enclosed Parking	.52				.300		-.586
27. Tot. Floor Space	.96		-.872	-.392			
28. Block Coverage	.86		-.901				
48. Population	.94	.909					
49. Institutional	.78				.801		.312

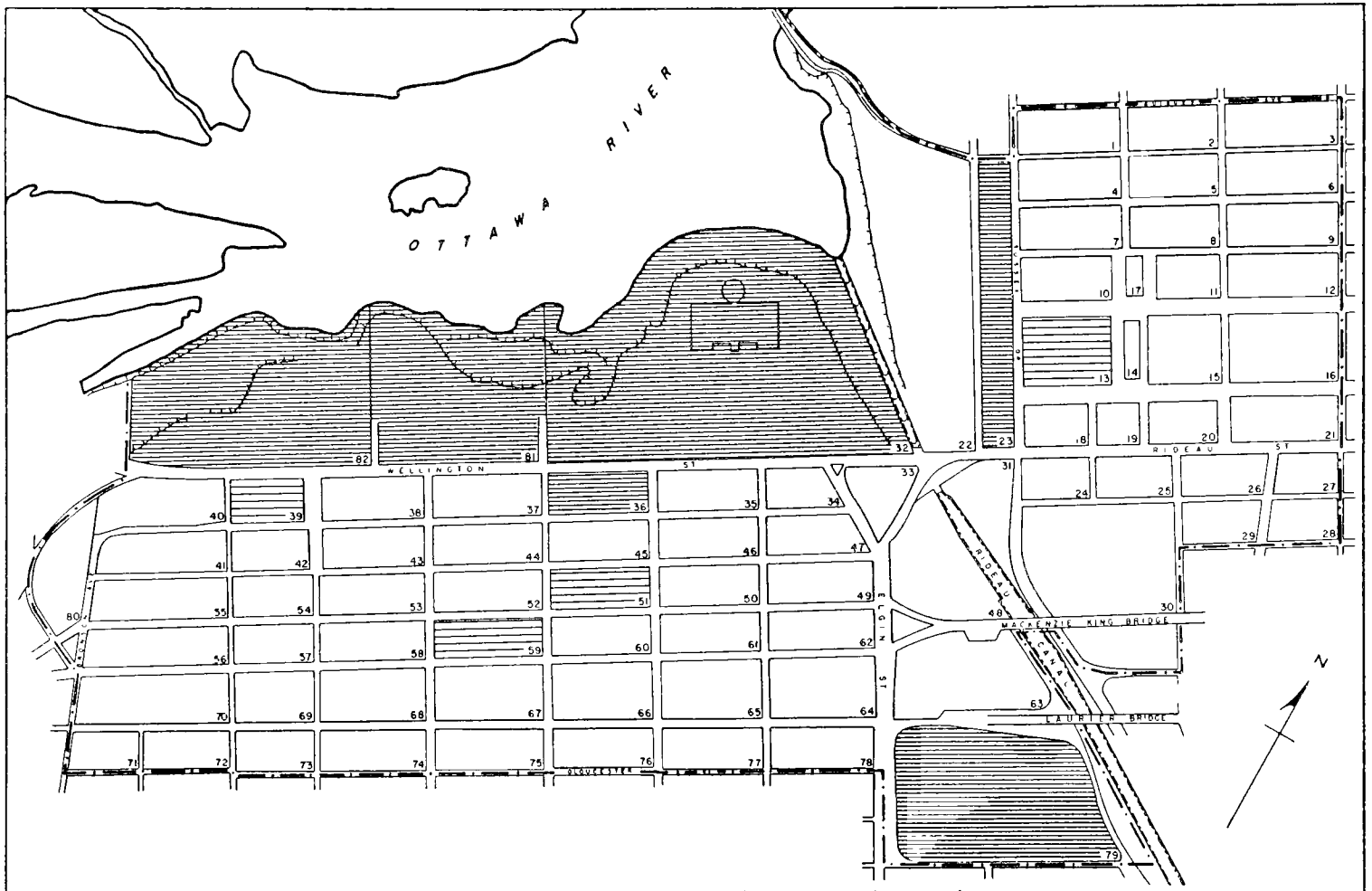
increased for each of the six factors specified. The factor structure remains essentially unchanged for both 1961 analyses; residential land use accounts for the greatest percentage of the variance and government office space ranks second in importance.

The distribution of blocks characterized by residential land use (map 27) shows two major concentrations; the first and most important concentration is located in the north-eastern section of the study area, the second is found in the south-western section extending eastward along Laurier avenue. Seventeen of the nineteen blocks specified by the component also appear on the Density of Construction map for 1961. The relationship defines a specific structural pattern for residential land use and verifies the importance of building stock data as a differentiating element in central area study. This structural pattern is defined by the variables 'total buildings' (.92) and 'floors above ground level' (.75).

The second factor, which accounts for 15.6 percent of the variance, establishes the federal government as a major space user in the Ottawa central area. The component actually demonstrates the intensity of government land use as previously defined in the building stock analysis; variables which obtain high scores on the factor are 'government office space' (-.92), 'block coverage' (-.90)and 'total floor space' (-.87). A comparison of maps 23 and 24 shows a strong relationship between government activities and land use intensity; eight of the ten blocks distinguished by the component appear on the Intensity of Occupation map for 1961. Government land use obviously focuses on Parliament Hill, along Wellington street and Sussex drive.


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
CANAL
N
FEET 0 200 400 600 800 1000 FEET
FLOOR SPACE ANALYSIS 1961; second analysis: rotated matrix
Factor I: Residential Land Use
>1.0
0.5 to 0.9

MAP 27

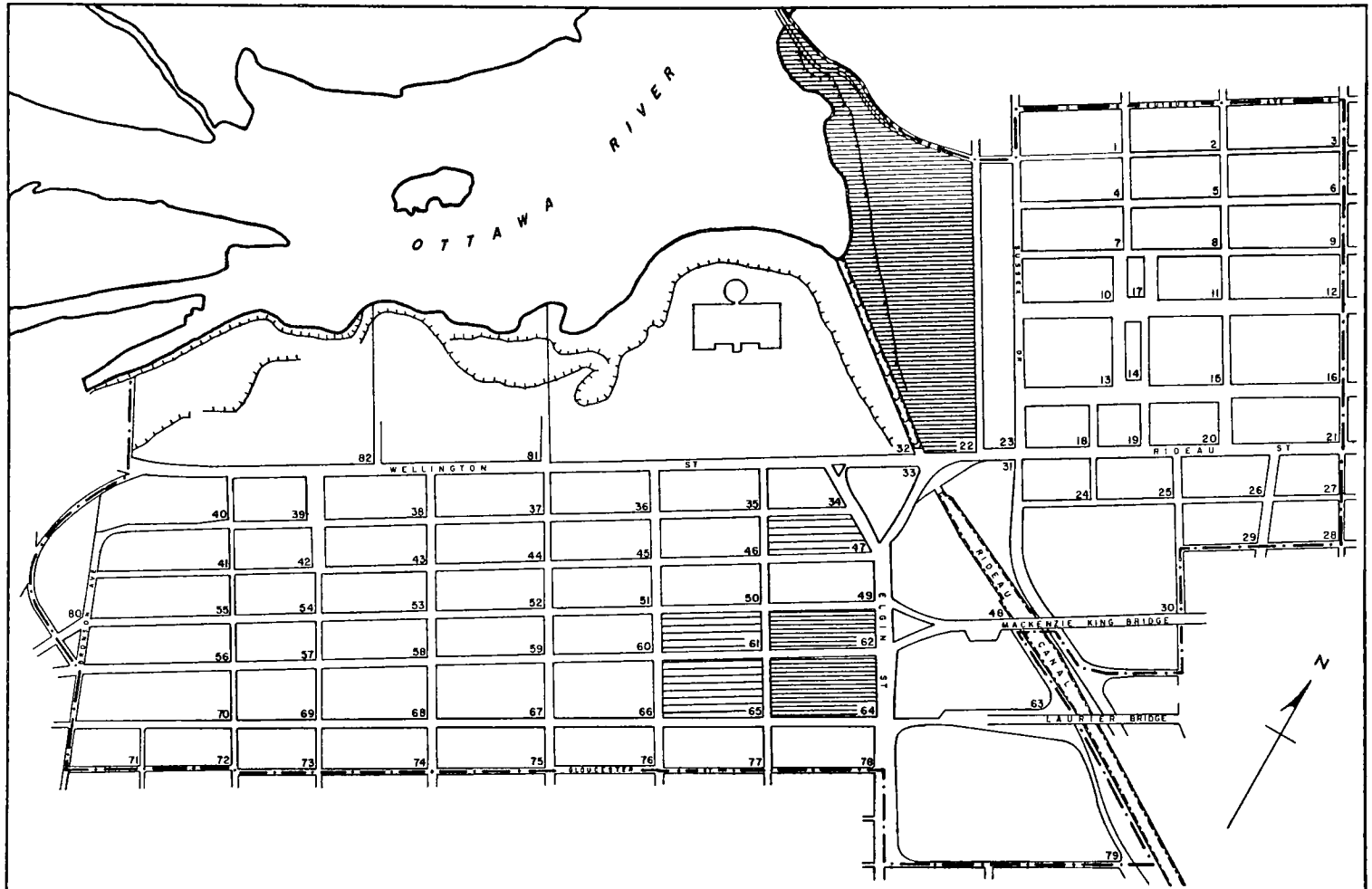

OTTAWA RIVER
WELLINGTON
RIDEAU ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
N
FLOOR SPACE ANALYSIS 1961: second analysis: rotated matrix
Factor 2: Government Office Space
< -1.0
-0.5 to -0.9
FEET 0 200 400 600 800 1000 FEET

MAP 28

The Cartier Square (block 79) site of the National Defense Headquarters until 1971, and particularly blocks 51 and 59 serve to indicate the extent of government office space in the Upper Town area. It is perhaps more significant that all spatial units appearing on the Intensity of Occupation map include federal government floor space.

The third component establishes a relationship between the hotel function, restaurant and entertainment, and office space. In the central area, the ground floor restaurant is commonly associated with the general purpose office building as well as with hotels. 'Total floor space' is weakly associated with the component (-.39); a return to the correlation matrix, confirms the association between this variable and the activities specified by the component. To some extent, the component describes a typical CBD block, associating a certain intensity of construction and tertiary activities. The distribution of blocks scoring significantly on the component is highly localized, however, distinguishing blocks with the exception of block 47, where the hotel function is significant (map 29).

The following component associates institutional and manufacturing activities. In the study area, manufacturing is comprised largely of printing and newspaper publishing. The land use association may best be understood in terms of occurrences. Activities classified within the manufacturing category are found in 24 blocks and institutional functions in 23 blocks; these activities occur together in ten blocks. Floor space devoted to manufacturing is considerably lower than that related to institutional functions, however; notable exceptions are the Journal and Citizen buildings, in blocks 44 and 46 respectively, which



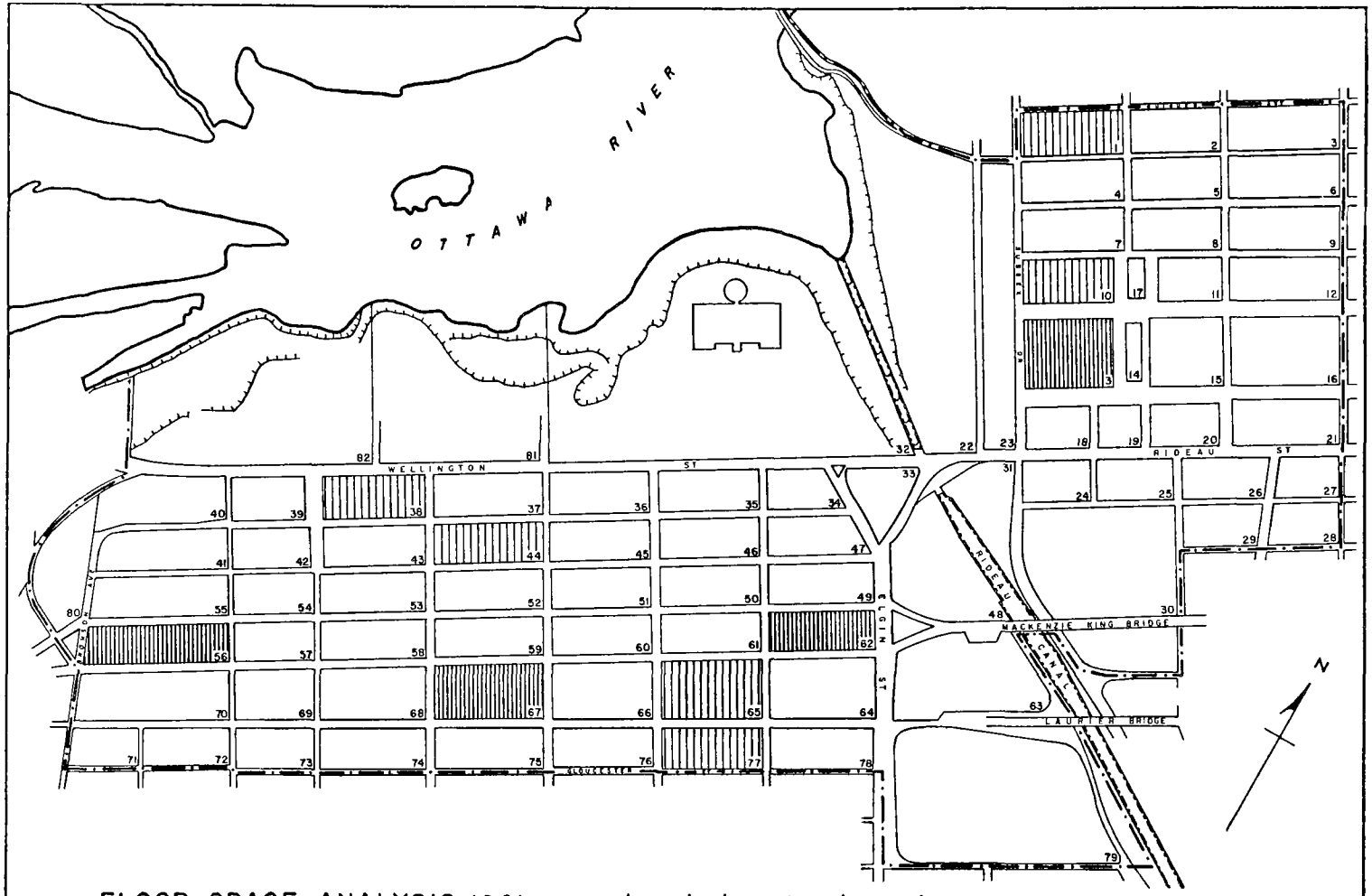
FLOOR SPACE ANALYSIS 1961: second analysis: rotated matrix

Factor 3: Hotel Function

 <0.1.0

 −0.5 to −0.9

MAP 29



FLOOR SPACE ANALYSIS 1961: *second analysis: rotated matrix*

Factor 4: Manufacturing and Institutional Activities

> 1.0

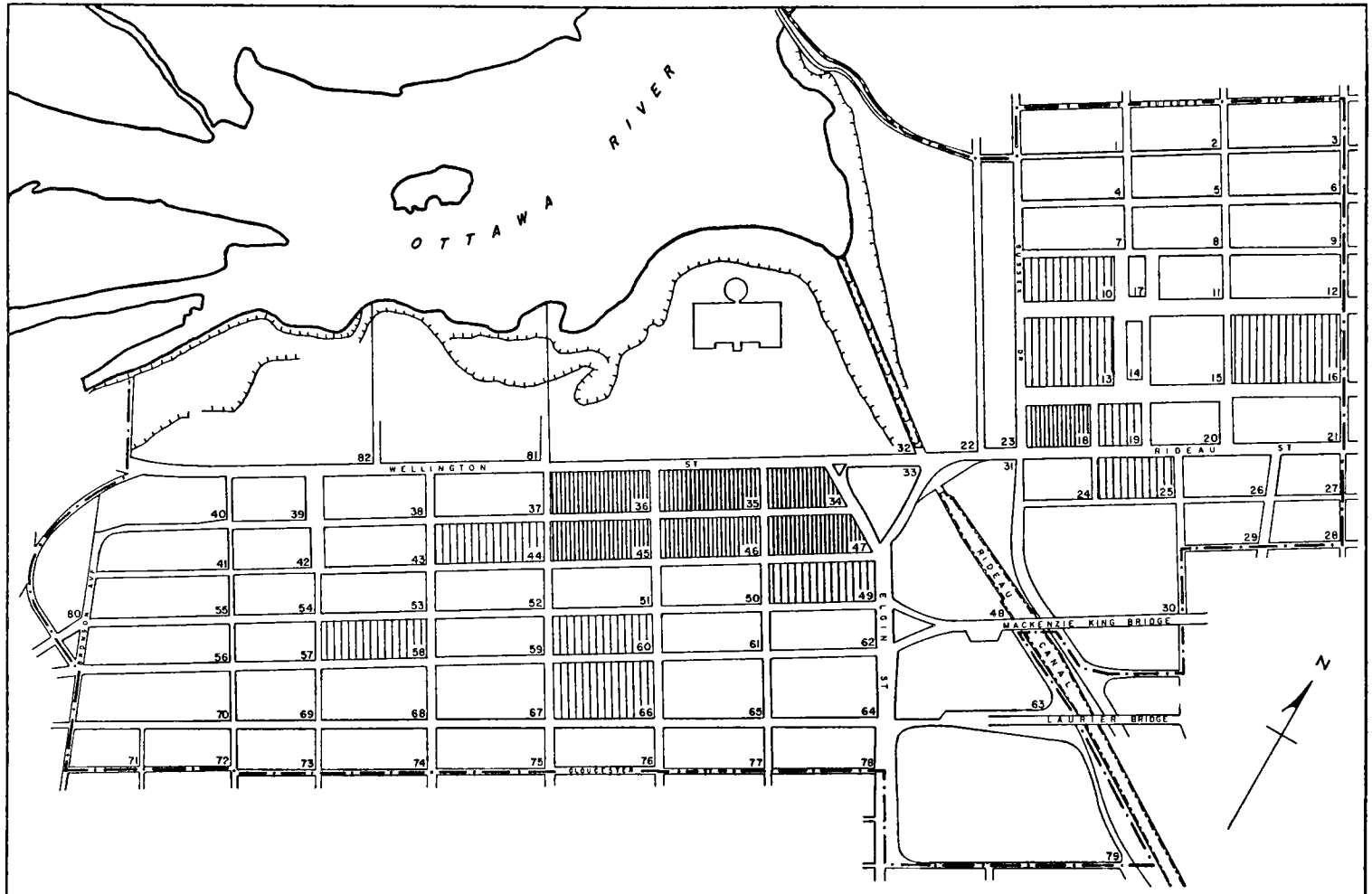
0.5 to 0.9

MAP 30

housed the two anglophone newspapers in 1961. The interpretation of map 30 therefore needs further comment. The factor scores isolate spatial units in which either the institutional function (blocks 1, 10, 38 and 56) or the manufacturing activities (blocks 13 and 44) are important as well as blocks in which both activities are found. The cartographic distribution suggests no specific distributional pattern other than the absence of concentration. If institutional activities are considered, a predominantly peripheral distribution may be discerned.

The fifth factor describes the importance of office space and retail activities. The variable 'storeys above ground' (.48) indicates a degree of land use intensity associated with the component. In 1961, the Roxborough Apartments, block 63, includes important diplomatic and office floor space; in the absence of retail activities and land use intensity this spatial unit does not appear on map 31. The distribution singles out known commercial arteries within the central area such as Rideau and Bank streets, a few blocks along the eastern facade of Sussex Drive, but most especially the Sparks street area south of Parliament Hill.

The last component distinguishes parking capacity as measured by both open (-.78) and enclosed parking (-.58). The weak opposition of 'institutional floor space' (.31) explains to some extent the central distribution of parking capacity shown on map 32. Parking is absent from block 34 and 46 however, indicating the influence of other variables such as 'manufacturing' (-.26), 'storeys above ground level' (-.21) and 'office: other' on the factor scores.



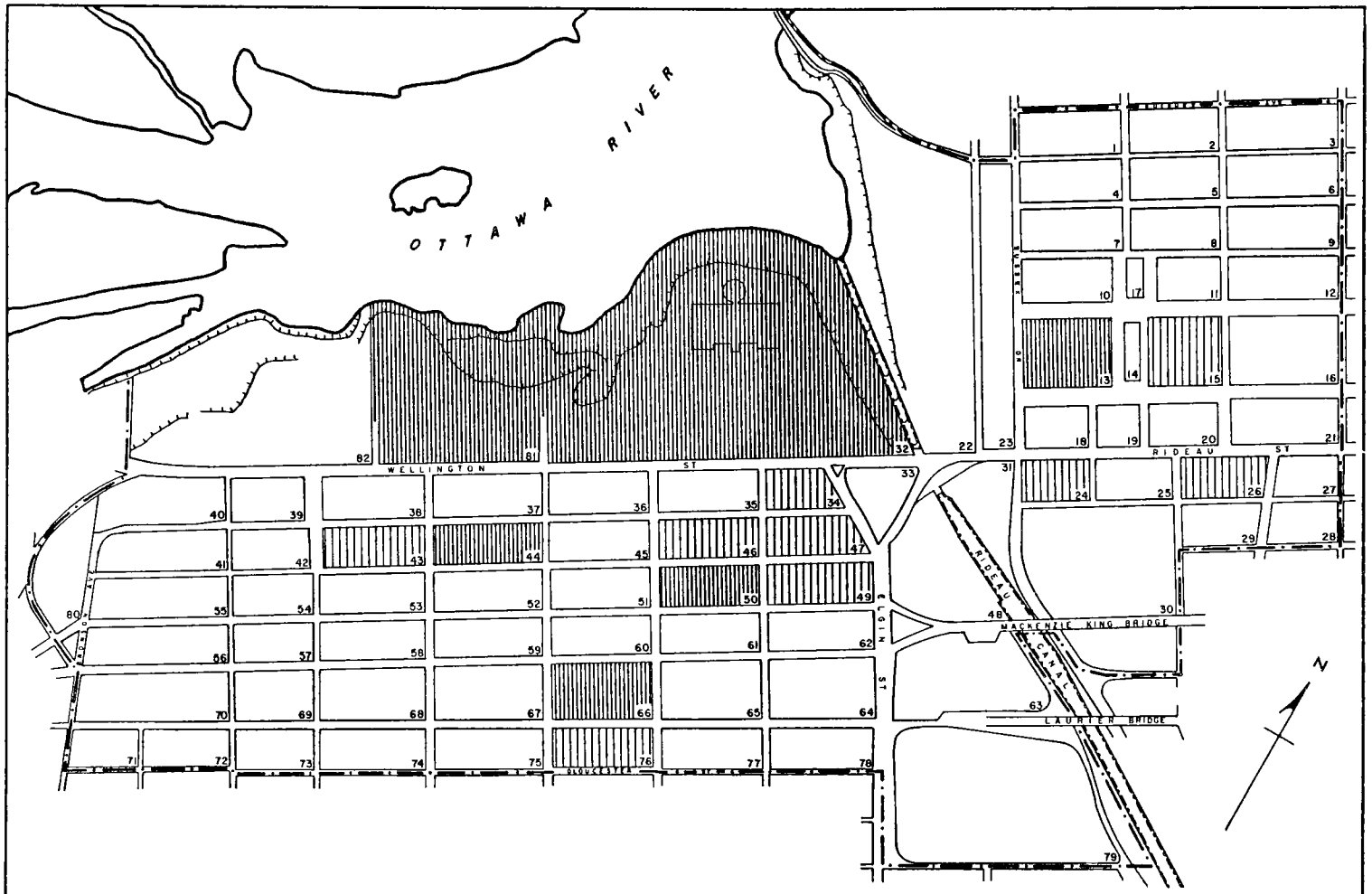
FLOOR SPACE ANALYSIS 1961: second analysis: rotated matrix

Factor 5: Office Space and Retail Activities

>1.0

0.5 to 0.9

MAP 31



FLOOR SPACE ANALYSIS 1961: second analysis: rotated matrix

Factor 6: Parking Capacity

>1.0

0.5 to 0.9

MAP 32

5.3.3. The Structure of Central Area Land Use: 1971

In the 1971 second floor space analysis the total variance explained by the six factors is 72.8 (table 18); only 1.4 percent explanation is lost following the removal of five variables. Two factors remain essentially stable throughout the decade: Residential Land Use and Goverment Office Space. The cartographic analysis reveals that there has been a considerable expansion of the traditional CBD functions, including government office space, within the study area.

The first two components, which explain the greatest percentage of the total variance, identify land use relationships characteristically associated with the CBD. Structural variables shared between the two components specify two types of structure relating to intensive land use.

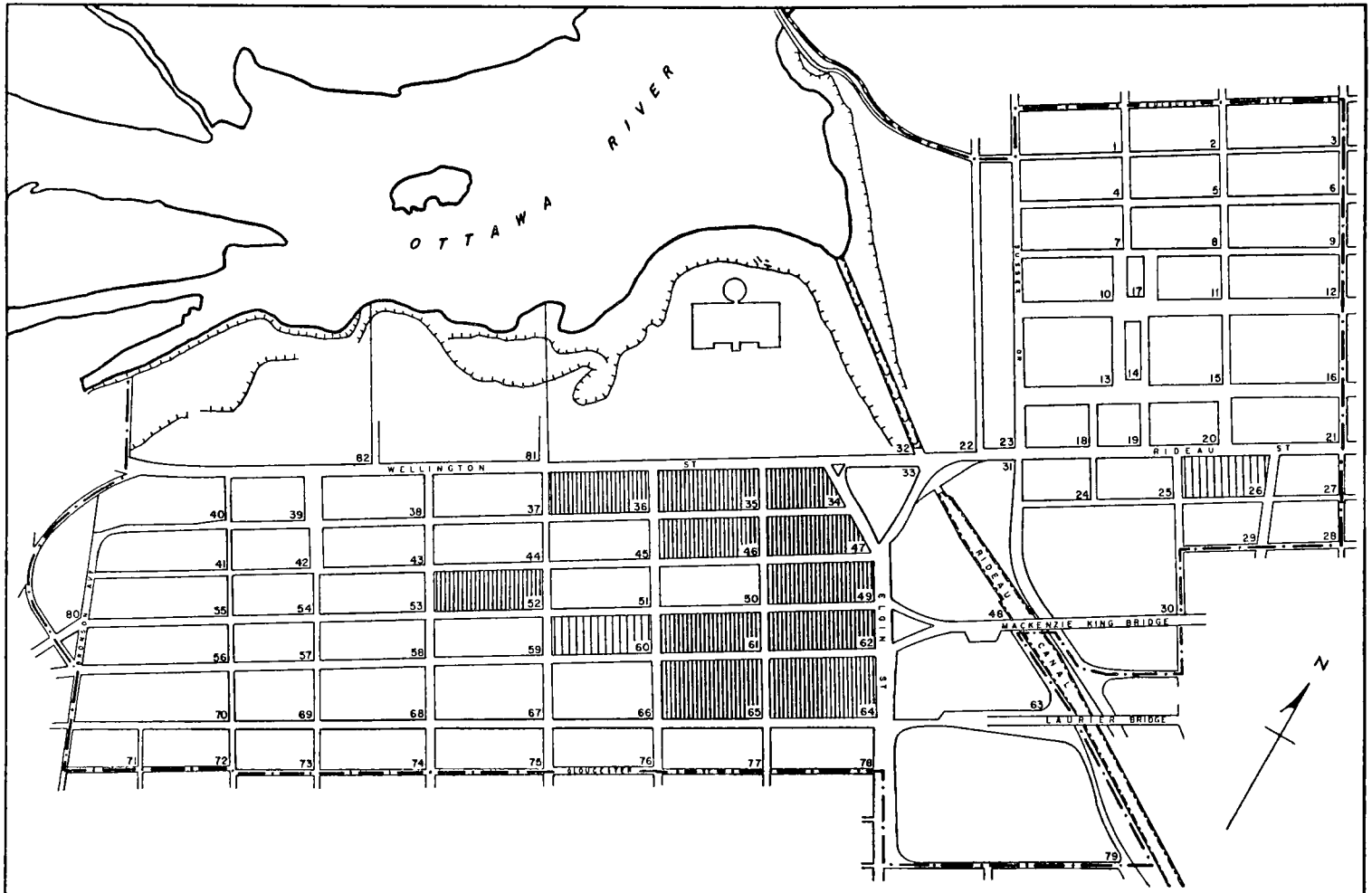
The first component General Office Space, which accounts for 17.5 percent of the variance, groups the various types of office space but excludes federal government activities (table 18). That the variable 'manufacturing' should obtain the highest loading on the component (.84), is an indication that it is comprised almost exclusively of printing establishments in 1971; other activities included within the secondary sector have increasingly moved out of the central area.

Structural variables associated with the component are 'storeys above ground' (.66) and 'total floor space' (.40). This measure of land use intensity is further verified by the structural analysis; 61 percent of the spatial units figuring on map 33 also appear on the Intensity of Occupation map for 1971. The distribution of office space, as defined by the component, is highly concentrated in the eastern section of the

TABLE 18

FLOOR SPACE ANALYSIS 1971: SECOND ANALYSIS:
ROTATED FACTOR MATRIX

Factor Number		1	2	3	4	5	6
Eigenvalue		2.9	2.7	2.2	1.6	1.4	1.2
Percent of Total Variance		17.5	16.3	13.3	9.6	8.5	7.4
Variable	Communality	General Office Space	Government Office Space	Residental Land Use	Entertainment and Enclosed Parking	Intensity of Occup. vs. Density of Occup.	Retail and Service Activities
29. Tot. No. of Buildings	.83	.668	.374	-.791			.326
31. Storeys Above Ground	.87			-.322		.396	
50. Residential	.73			-.811			
51. Residential Commercial	.55					.541	
52. Government	.78		.823				
53. Finance	.65	.788					
54. Diplomatic	.44	.561					.338
55. Other Office	.57	.736					
56. Ret. Serv. and Repair	.79						.871
58. Rest. and Entert.	.85				.919		
60. Manufacturing	.74	.848					
63. Open Parking	.68		.743				
64. Enclosed Parking	.68				.702	.370	
32. Tot. Floor Space	.92	.400	.728		.310	.360	
22. Block Coverage	.80		.818				
65. Population	.86			-.877			
66. Institutional	.56						-.667



FLOOR SPACE ANALYSIS 1971: second analysis: rotated matrix

Factor I: General Office Space

>1.0

0.5 to 0.9

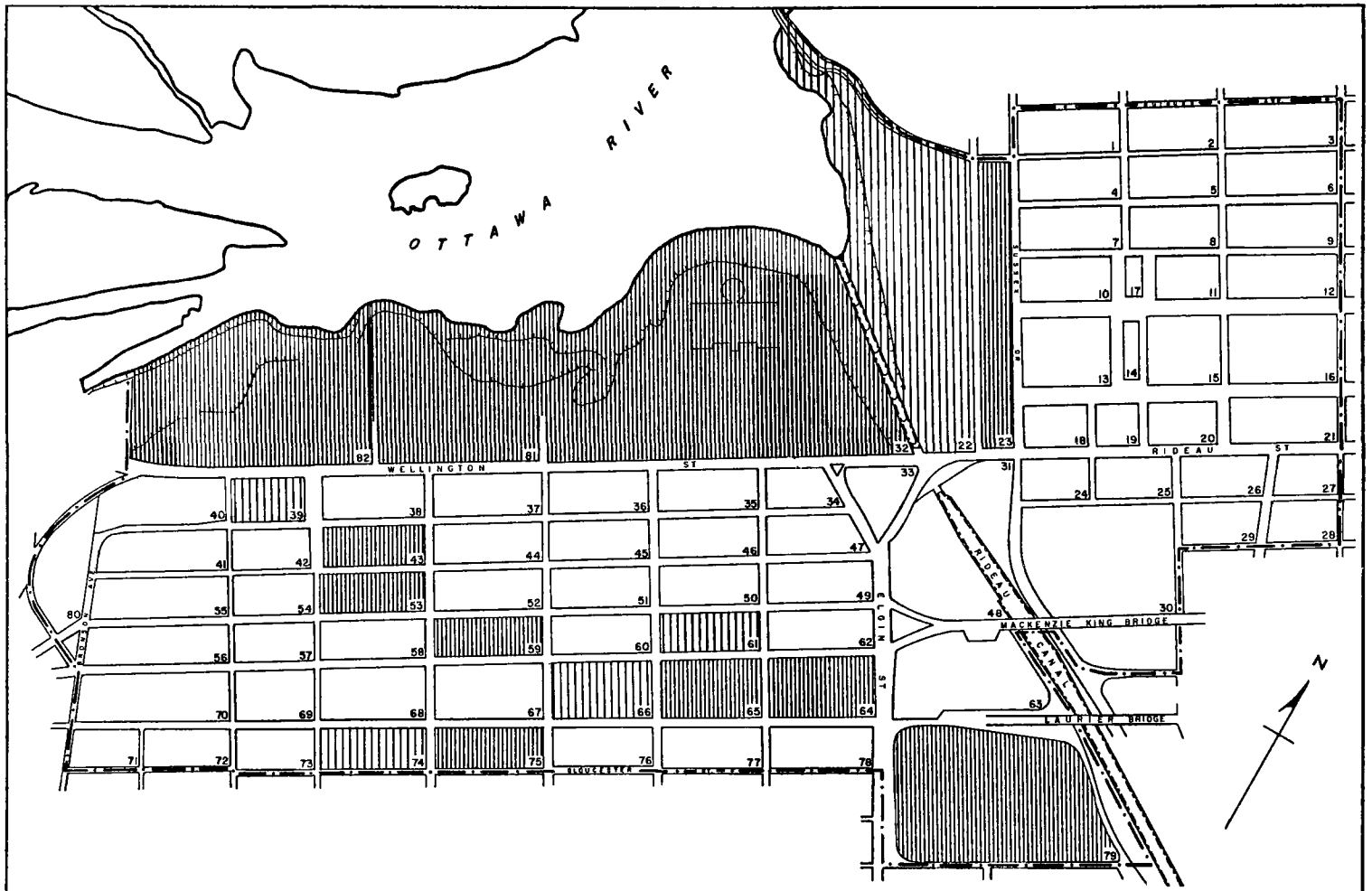
MAP 33

Upper Town area bounded by Wellington and Elgin streets, Laurier Avenue and Bank street.

The spatial distribution of blocks associated with the second component, Government Office Space, (map 34) is more closely related to the Intensity of Occupation map to the point that the two maps are almost identical. From Wellington street extending diagonally across the area west of Bank street, government land use draws a circle around the office section of Upper Town. This is not to mean that government office space does not occur in that area as well, especially since the close of the circle coincides with some of the same blocks identified by the previous component. Contrary to the general impression given by map 34 all blocks included on the first component map, with the exception of block 46, include some degree of government office space. Therefore, an important differentiating element between the two components, over and above the various land uses, is the structural stock.

The structural variables associated with government land use are 'block coverage' (.81) and 'total floor space' (.72). In this context, the relationship is the same as that expressed in 1961. The importance of block coverage is undoubtedly related to the size of federal properties and distinguishes a type of construction commensurate with large land holdings. The gargantuan proportions of the edifice built to house the National Defense staff is a recent example (block 30).

A fourth variable 'open parking' (.74) is added to the component in 1971. The relationship between this variable and government floor space assumed in the first analysis for 1971 is therefore confirmed.



FLOOR SPACE ANALYSIS 1971: second analysis: rotated matrix

Factor 2: Government Office Space

>1.0

0.5 to 0.9

MAP 34

The necessity for increasing parking space may be related to the general expansion of government facilities during the decade.

The third component, Residential Land Use, retains essentially the same variable definition as 1961, but the importance of the factor, as measured by the variance, falls from 18.5 percent to 13 percent in 1971. This is one relevant indicator of the changes which have occurred in the Ottawa central area during the decade. Only the building stock definition has changed somewhat due to the changing role of the variable 'storeys above ground level'; this variable obtains a much lower factor loading of -.32 on the Residential Land Use component as opposed to .75 in 1961.[1] The correlation matrix indicates that there is no relationship between this variable and 'residential floor space' (.04); in 1961, however, the correlation coefficient was .46. The 'number of buildings' becomes the only structural element associated with the residential function in 1971. This changing relationship implies that there has been an evolution of the residential building stock during the decade.

Although the central area has undergone a decrease in population of about 30 percent between 1961 and 1971, the spatial distribution has changed very little. Only block 49 appearing on map 35 does not include resident population.

The fourth component associates entertainment (.92) and enclosed parking (.70). The weight of the variable 'total floor space' (.31) is also revealing since the correlation between this variable and 'enclosed

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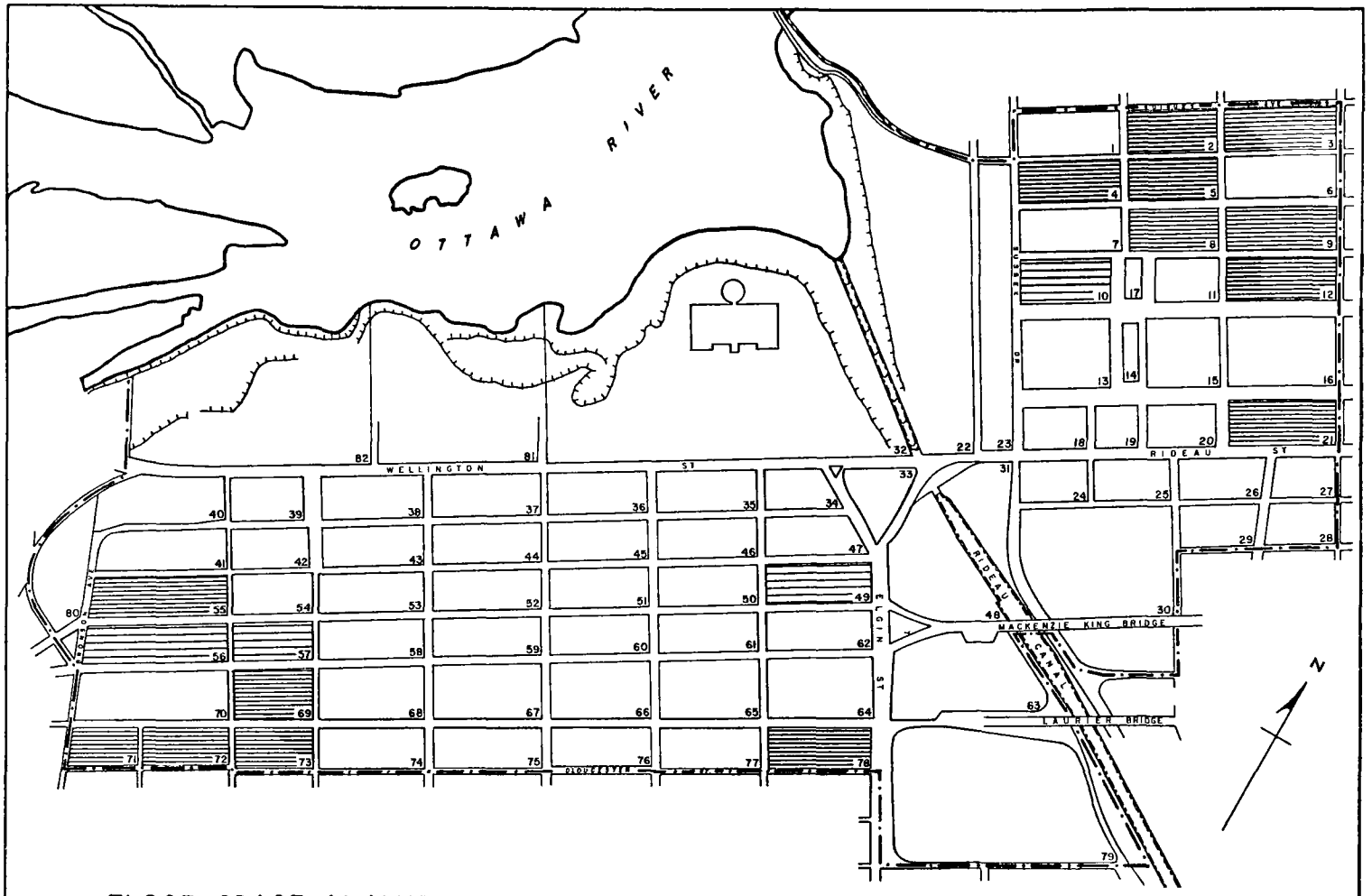
[1]The sign difference is not relevant as it only indicates the position of the variables on the factor.



FLOOR SPACE ANALYSIS 1971: second analysis: rotated matrix

Factor 3: Residential Land Use

<2 <-1.0

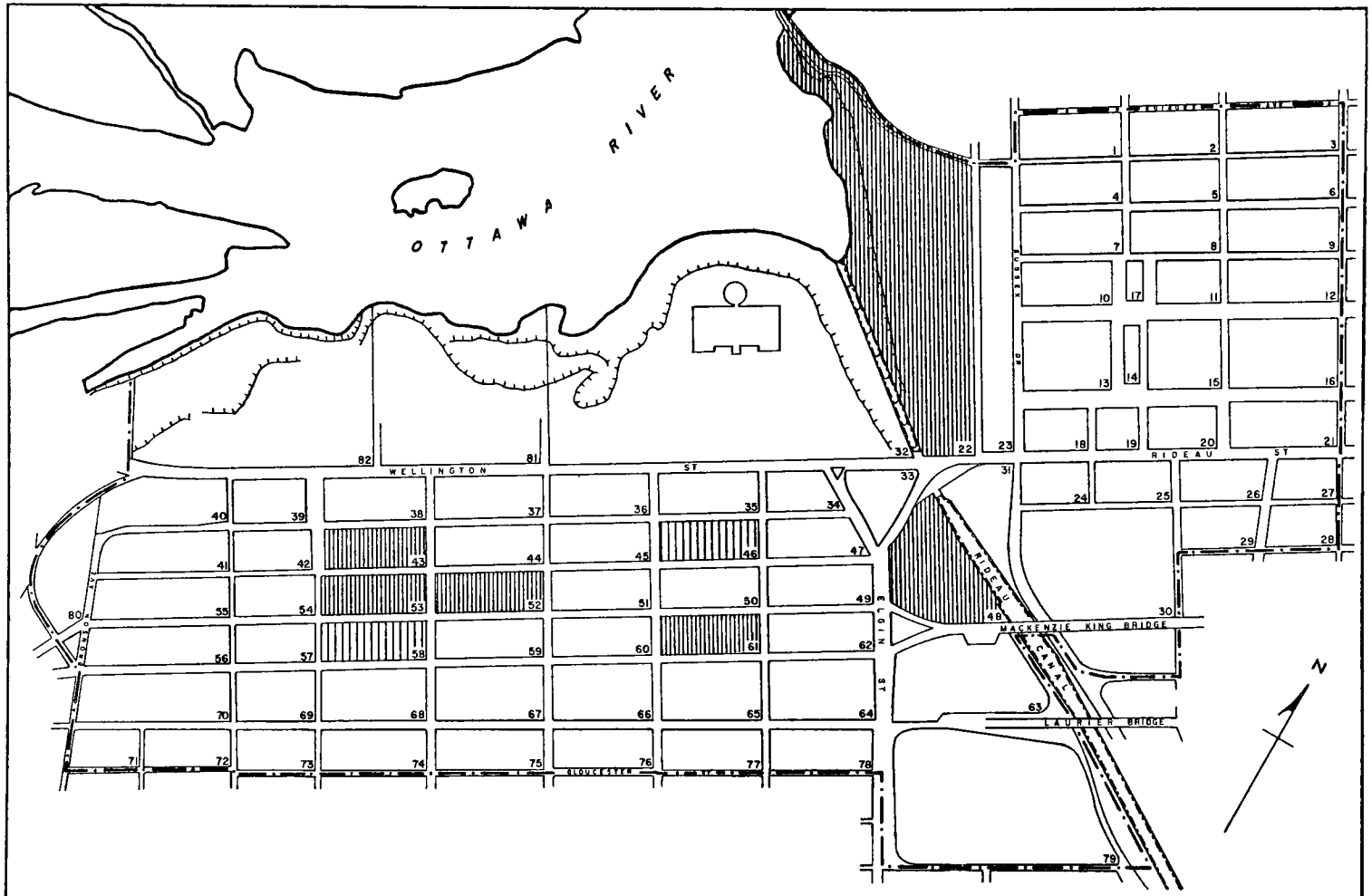
<1 −0.5 to −0.9

MAP 35

parking' is .43. Five of the eight blocks singled out on map 36 include hotels although this activity achieves a relatively low score of .28 on the component. The component therefore highlights some of the major land use changes which have occurred in the central area. One of these changes, featured in the Place de Ville complex, is characterized by increasing land use intensity. Such developments also entail specific land use associations such as the hotel function, office space, and retail activities which ultimately comprise but a small percentage of the total floor space area. This multiplicity of functions adds a much needed variety to the Ottawa central area. Associated with such construction but also responding to other land use constraints is the provision for enclosed parking in the central area. Remarkable underground parking facilities are found below the National Arts Centre (block 48) as well as below the Place de Ville complex; the parking capacity for these three blocks alone is totalled at 2,248. Block 22 features a parking garage which was recently added to the Chateau Laurier edifice.

Enclosed parking may be considered a measure of the Intensity of Land Occupation. Underground parking is a direct response to the constraints of land economics as well as the growing demand resulting from rapid expansion of downtown facilities. Open parking, on the other hand may be related to land speculation in central areas; this is one indication that the land use in question is only temporary. Obvious exception is made for the large expanses of parking on government properties.

The importance of parking in central areas is also intrinsically



FLOOR SPACE ANALYSIS 1971: second analysis: rotated matrix

Factor 4: Entertainment and Enclosed Parking

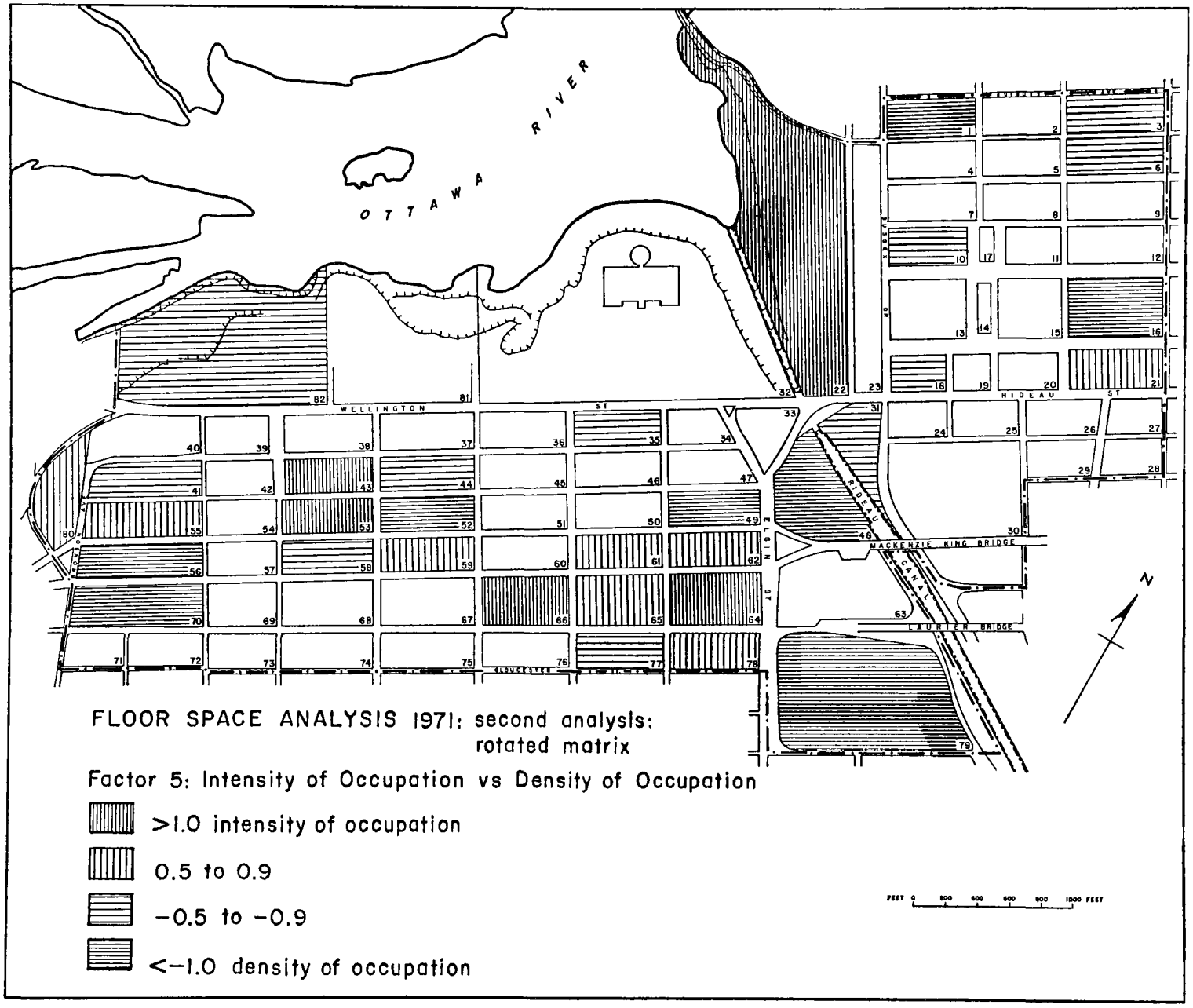
>1.0

0.5 to 0.9

MAP 36

related to transportation technology. Improvements in mass transportation would alleviate the urgency for downtown parking. Assuming that such improvements, as well as other incentives, would succeed in curtailing automobile transportation, higher economic returns for a parcel of land could be only one of several possible benefits. Natural areas, such as the south shore of the Ottawa River, could be successfully landscaped; this would increase green space facilities in proximity to the downtown core. The development of recreational facilities in that area would be of appreciable importance to local residents as well as downtown employees, notwithstanding its general attraction for a city in which the tourist activity contributes a significant share to the total revenue. The intensification of parking facilities nevertheless remains an immediate adaptive response to rapid changes occurring in the downtown area.

The following component entitled Intensity of Occupation versus Density of Occupation accounts for 8.5 percent of the variance. The strong loadings on this fifth factor oppose two types of land uses: hotel (.54) and institutional floor space (-.66). The component is essentially an expression of structural diversity as exemplified by the aforementioned land uses. On the positive side of the component the hotel function is associated with 'storeys above ground level' (.39), 'enclosed parking' (.37) and 'total floor space' (.36); on the negative side, institutional activities are associated with 'total buildings' (-.24) and 'block coverage' (-.23). There is some degree of correspondance between the distribution appearing on map 37 and the maps portraying the distribution of the two structural factors defined


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
CANAL
N
FEET 0 200 400 600 800 1000 FEET
FLOOR SPACE ANALYSIS 1971: second analysis: rotated matrix
Factor 5: Intensity of Occupation vs Density of Occupation
>1.0 intensity of occupation
0.5 to 0.9
-0.5 to -0.9
<-1.0 density of occupation

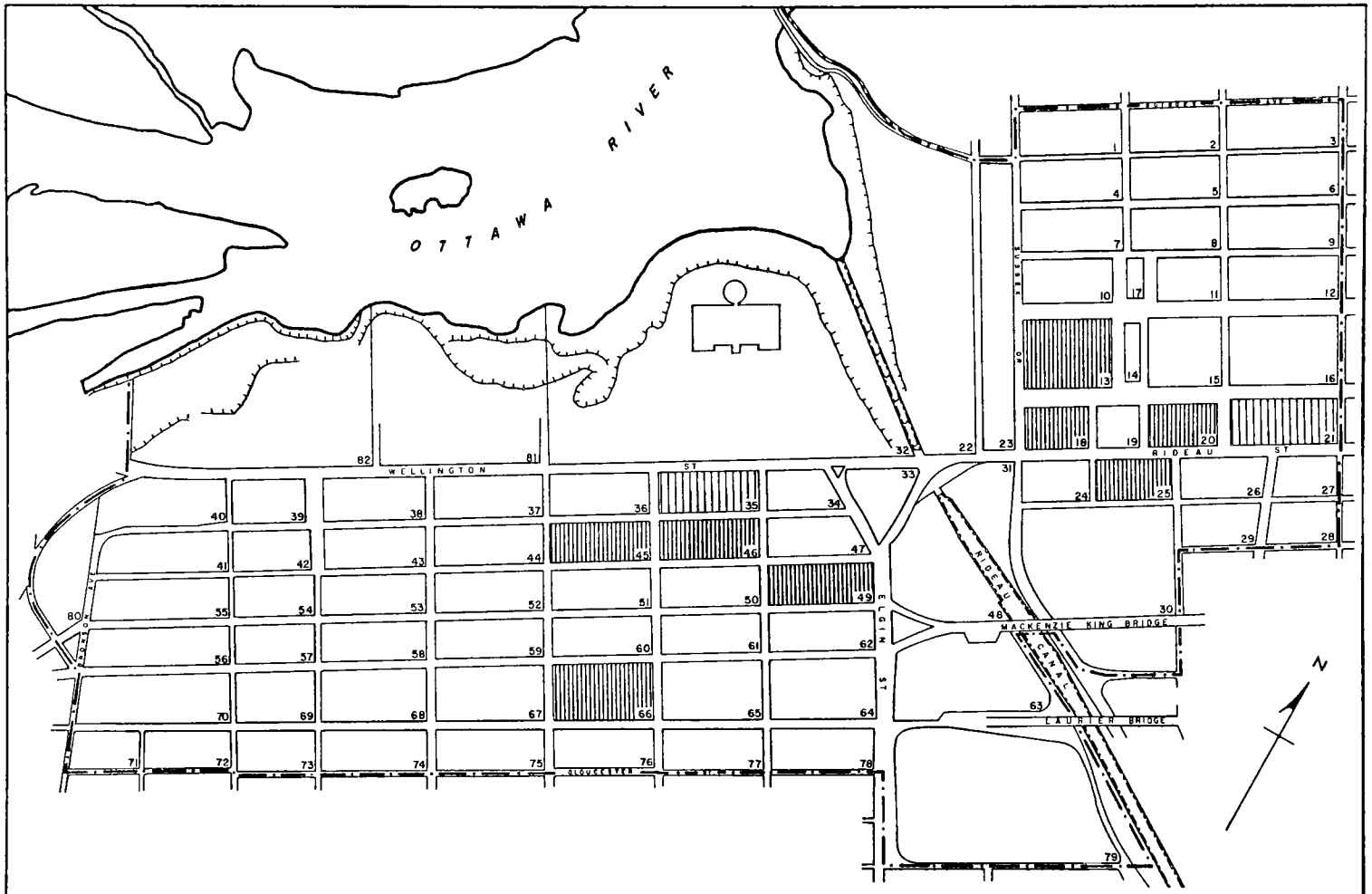
MAP 37

for 1971, but there are also startling reversals. Some blocks previously characterized by intensive occupation are now associated with the density aspect of the component; such is the case for block 79 which includes a substantial quantity of institutional floor space, and blocks 48 and 52 for which block coverage is significant. These reversals are therefore due to the land uses specified by the component and to the complex structural relationships previously noted.

The last factor isolates retail activities in the central area. The retail function is no longer strongly identified with office floor space in 1971. Office space has increased considerably during the decade, but retail and service activities have not grown proportionally. The only significant retail facility added to the downtown area is located in the enclosed shopping mall below the Place de Ville complex. Small retail shops as well as restaurants and other services are sometimes planned on the ground floor of new office buildings. The spatial distribution has therefore not altered significantly from that indicated in 1961; the two nuclei of retail activities, Rideau street and Sparks street, are still apparent (map 38).

5.3.4. CBD-forming versus non CBD-forming Activities

Factors in both analyses have succeeded in distinguishing between CBD-forming activities and non CBD-forming activities. The spatial distribution of these components adds further emphasis to this distinction. In this context, government activities must be considered a CBD function in Ottawa for two major reasons. First of all, several government agencies or offices are attracted to the central area because



FLOOR SPACE ANALYSIS 1971: second analysis: rotated matrix

Factor 6: Retail and Service Activities

>1.0

0.5 to 0.9

MAP 38

of its accessibility to other federal as well as non-federal agencies. The importance of communication, although not specifically studied in this analysis, cannot be overemphasized given the national and international scope of government functions. Secondly, the presence of government office space contributes significantly to the existence and growth of the Ottawa central area as a central place. The importance of the government labour force sustains various retail and service establishments and also contributes to their growth. Notwithstanding the general decline of retail sales in the central area due to increasing suburban competition during the sixties, an increase of over 10 million dollars in clothing and apparel sales between 1961 and 1966 has been attributed to the growth of federal employment in the central area.[1]

Similarly, ample evidence is given in the first floor space analysis to define wholesaling as a CBD-forming activity where such facilities are attracted by the pull of centrality. Obviously, Ottawa may not be compared to the average north american industrial city in view of the administrative function it has acquired as early as 1857. The relocation of railway facilities during the sixties has also had an impact on the type of wholesaling activity now found in the central area.

Other activities are disappearing from the central area; these are land uses which do not require a central location. Their declining

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[1] Figures reported in Etude de la zone centrale d'Ottawa (1969) prepared for the City of Ottawa by Hammer, Greene, Siler Associates.

importance during the decade is the result of growing space demand for CBD functions. The evolution of institutional land use is slower however; in this case, historical and architectural considerations come into play. Although institutional and civic activities are not considered CBD-forming activities, they add a cultural dimension to the central area. The Sparks Street Mall, the Lower Town market place, the renovated buildings along historical Sussex drive, housing various boutiques, are sites and places incorporating activities and linkages which transcend the strict functional concept of the central business district. Such elements, sorely lacking in north american CBDs, add considerably to the image, character and atmosphere of central areas. Yet their presence has either been ignored by functional analyses or noted as a means of elucidating anomalies or land use evolution. Ottawa is fortunate in that municipal and federal planning bodies have endeavoured with appreciable success to incorporate these social and cultural elements with other business land uses.

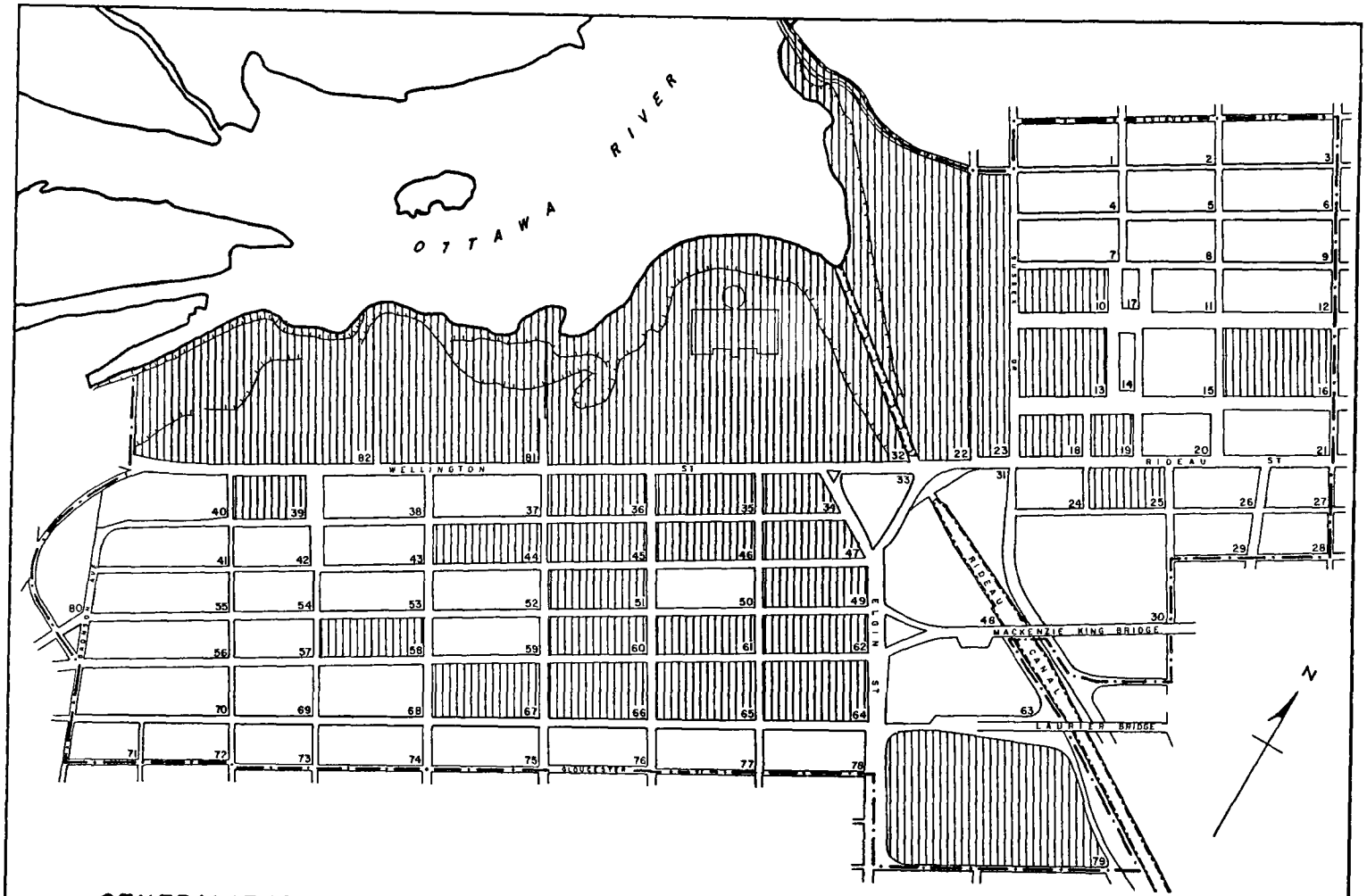
Such people oriented activities need not be located at the margin of the business section as the Sparks Street Mall has successfully demonstrated. Residential land use, however, remains a distinctly peripheral phenomenon. Religious and educational structures obviously maintain close links with these residential neighbourhoods; some churches have also established specific services in order to deal more effectively with the needs of a transient population.

5.4. Evolutionary Trends

The impressive changes which have occurred in the Ottawa central

area between 1961 and 1971 are twofold: vertical and horizontal. The vertical growth of central area facilities is more dramatically verified in the structural analysis. In 1961, the Intensity of Occupation component is largely overwhelmed by the importance of government facilities. The relationship between the 'number of storeys above ground level' and 'total floor space' in 1971 is an expression of the developing vertical structure in that area south of Wellington street. This is further verified by the floor space analysis for 1971 which suggests two types of building structure associated with CBD activities. The first type distinguishes government facilities. In this instance, the importance of block coverage implies a relationship between government building stock and size of property. Architectural considerations also exert pressure in a city conceived to be a national showplace. Monumental constructions on federal properties are nevertheless more practicable in the absence of confining property lines. For most properties in the central area, however, the morphological constraints of the grid system and the ensuing land allotments have forced an intensification of the building-to-land ratio. Building structure is therefore defined in terms of floor space and storeys above ground.

The spatial or horizontal growth of the Ottawa CBD may be verified by means of two composite maps. Each map groups factors relevant to the definition of CBD functions for both 1961 and 1971. The spatial distribution therefore identifies the core area of the Ottawa CBD. Map 39 shows the distribution of blocks identified in 1961 by factors Government Office Space, Hotel Function, and Office Space and



GENERALIZED DISTRIBUTION of CBD FUNCTIONS

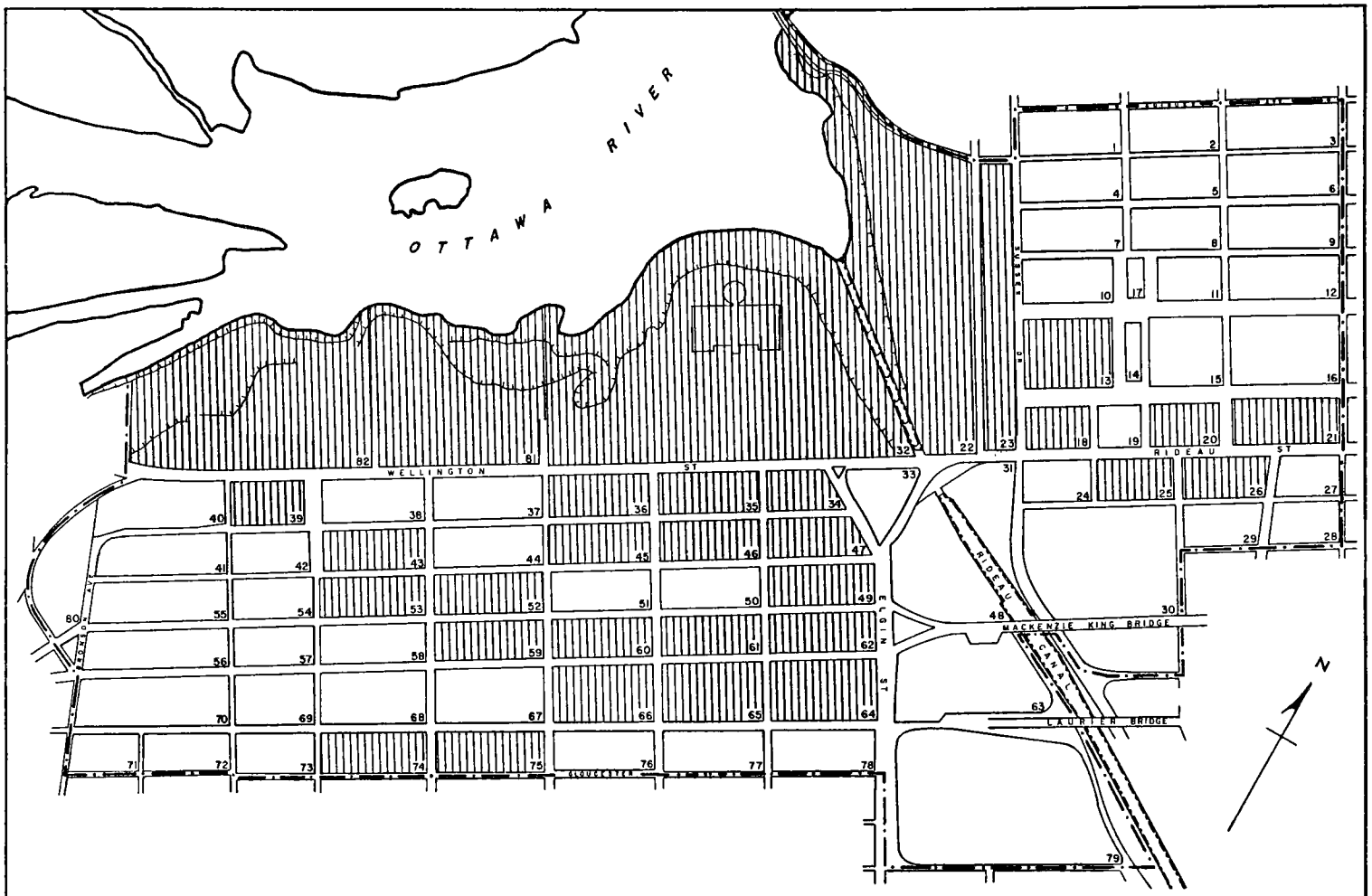
within the OTTAWA CENTRAL AREA: 1961

MAP 39

Retail Activities. The distribution includes large government properties along the south shore of the Ottawa River and distinguishes the very prominent position of the eastern section of Upper Town. In 1961, the Lower Town extension along Rideau and Sussex streets emphasizes blocks for which both retail and office floor space are significant.

Map 40 indicates the distribution of blocks identified in 1971 by factors General Office Space, Government Office Space, and Retail and Services. The distribution largely coincides with the 1961 composite map, but reveals a marked increase in CBD activities in the area west of Bank street. The retail factor has clearly identified Rideau street as a predominantly retail district such that the blocks added to the 1971 composite map do not necessarily indicate an expansion of CBD activities in that area; the identification of these blocks by the retail factor recognizes the importance of retail activities and more significantly, the relative decline of office floor space.

A closer analysis of the 1971 composite map reveals that several blocks within or situated at the periphery of the core area are either presently under construction or slated for redevelopment in the near future. Construction was underway during the early seventies in blocks 37, 44, 51 and 76. As previously indicated, half of block 50, presently occupied by a parking garage and printing facilities among other land uses, is scheduled for redevelopment. All of block 58 has been recently purchased by Rockford Developments Limited although plans for that site have not been finalized. Block 38 does not attain CBD status because of the institutional floor space found within the block; but even



GENERALIZED DISTRIBUTION of CBD FUNCTIONS

within the OTTAWA CENTRAL AREA: 1971

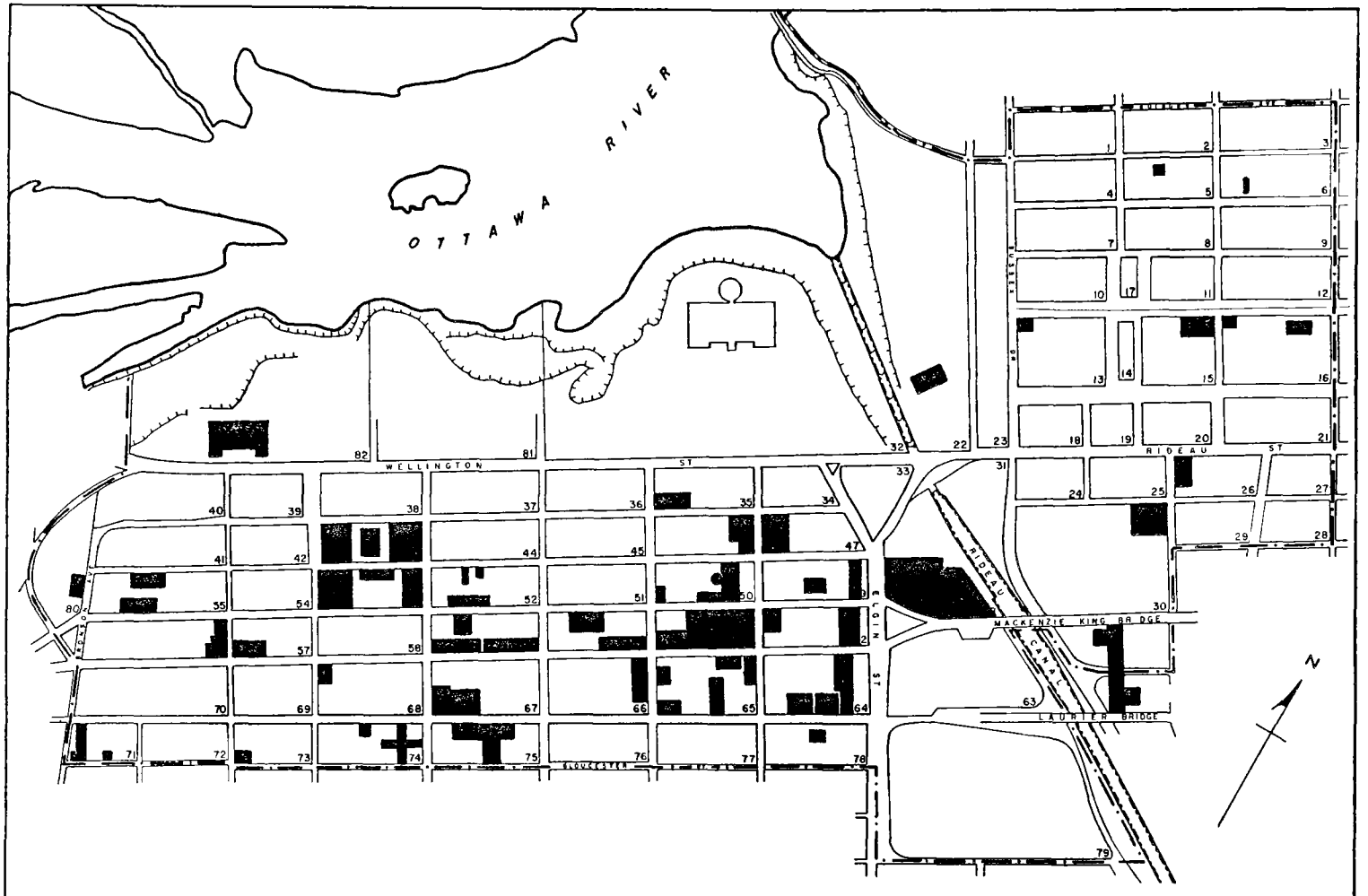
MAP 40

St. Andrew's Presbytarian Church plans to devote a portion of that site to the construction of an office building.

Vertical expansion remains the most significant dynamic element for the central area. Map 41 indicates the distribution of buildings constructed between 1960 and 1970. A large percentage of the construction has occurred in that area bounded by Wellington, Elgin, Laurier and Bank streets, already identified in 1961 as the core of CBD activities. Extensive development of the area west of Bank street is also evident.

New constructions witnessed in blocks 54, 71, 73 and 81 (map 41) are apartment buildings. They forecast a rising trend apparent in other north american cities: the return of the population in close proximity to the downtown core. These new constructions often involve luxury apartments, in response to rising land values, although the quality of the neighbourhood has impeded such development until recently. The displacement of local residents is nevertheless high as evidenced by the rate of population decrease for the central area during the decade. As poor quality housing is replaced by higher density apartment buildings, a new wave of residents is expected to reverse this downward trend.

The character of the Lower Town residential section is not expected to change so drastically although considerable commercial encroachment has occurred in the north-eastern section of the study area. Moneys are being spent in order to retain the historical character of Lower Town and in essence to maintain a medium density profile. The most pertinent example is the 'mile of history' along Sussex drive



BUILDING CONSTRUCTION in the OTTAWA CENTRAL AREA 1960 to 1970

Source: Ottawa Planning Area: Official Plan: Amendment no.62, appendix VIII, schedule D, 1971.

MAP 41

where several properties owned by the NCC. have been completely renovated, often incorporating both the commercial and residential functions. It would seem almost essential to maintain the housing characteristics of the neighbourhood, extending well beyond the study area, in order to preserve the historical intimacy promoted by the NCC..

The character of residential land use, its structural evolution, are therefore not uniform for the two residential zones identified. These areas are too small and the variables too few to allow the factor structure to differentiate between them. Generally speaking, change has been slower and less dramatic for these peripheral zones. The number of buildings, indicative of a certain density of construction therefore remains important for both analyses; the structural relationship does change, however, revealing that the increasing residential density noted for Upper Town has a pertinent influence on the definition of the structural stock.

The evolution of land use association is indicative of selective processes at work during the decade; activities which are large consumers of land or which can ill afford rising land values such as manufacturing, warehousing, and auto sales and services are leaving the central area. New construction has focused on increasing office space, for both private and crown use, hotel space and to a more limited extent, retail area. The declining importance of residential land use within the factor structure is also a manifestation of these selective growth processes.

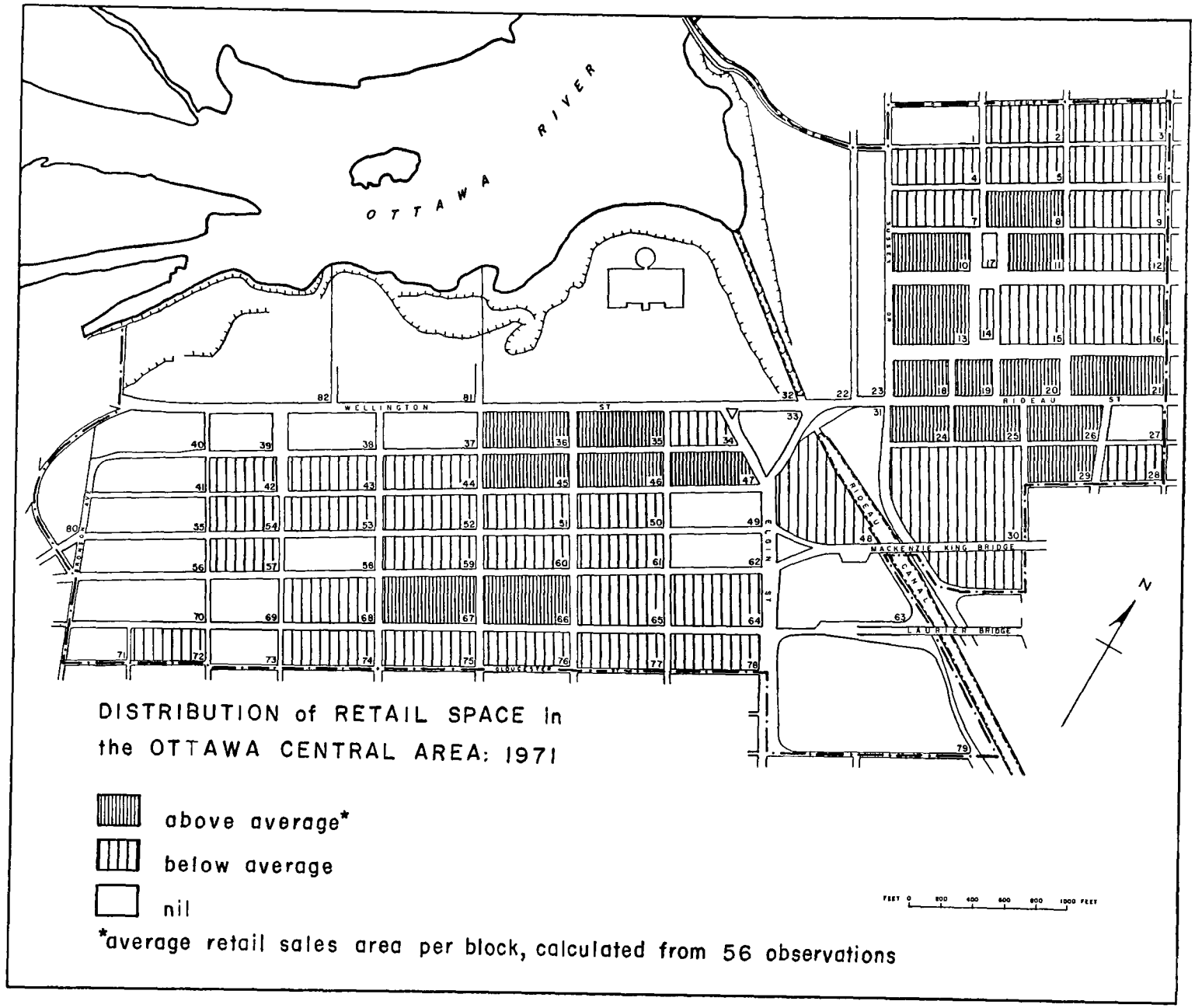
The impetus for such change is largely provided by federal government policy. The decentralization policy adopted shortly after the Second World War resulted in the construction of several large complexes

by the federal government at strategic locations throughout the city (Coleman, 1969). The decision taken by the government to increase rented space, the mitigation of restrictive zoning by-laws for the central area, resulted in a construction boom which is carried on well into the seventies.

5.5. Retail Activity: a Functional Study

The Ottawa CBD covers a relatively small area so that distinct functional districts are not discernable. The floor space analysis nevertheless reveals that the retail function exhibits marked concentrations along arteries such as Sparks, Rideau and Bank streets. This distribution also corresponds most vividly with the visible landscape; retail activities are not organized at the block level but at the street level. Map 42 which shows the distribution of retail space serves to emphasize the importance of commercial activity in the central area and particularly in Lower Town; outlets on Rideau street alone accounted for approximately 45 percent of retail sales in the central area in 1969. Retail outlets generate pedestrian traffic but choice locations are those for which such traffic is maximized by the presence of other functions in the central area. The floor space analysis verifies this relationship but the variable 'retail, services and repair' gives little insight as to the type of retail activities found in the central business district.

In order to assess the character of retail activities found in the CBD in 1971, as opposed to those not associated with CBD functions, six types of retail activities were identified. This cursory


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
QUEEN ST
ELGIN ST
RIDEAU
MACKENZIE KING BRIDGE
CANAL
LAURIER BRIDGE
GLOUCESTER
DISTRIBUTION of RETAIL SPACE in
the OTTAWA CENTRAL AREA: 1971
above average*
below average
nil
*average retail sales area per block, calculated from 56 observations
FEET 0 200 400 600 800 1000 FEET

MAP 42

classification is conditioned by the availability of data and by the fact that greater detail increases considerably those spatial units with no occurrence. Hypothetically, the categories 'general merchandise' and 'apparel and accessories' should distinguish the important retail arteries in the central area; other categories such as 'food stores', 'automobile sales and accessories' and 'hardware stores' should be characterized by different land use associations. Food stores include the sale of goods for which demand is infrequent such as the candy store and the delicatessen as well as the small corner store which caters to neighbourhood needs. This lack of discrimination should influence its relationship with other retail activities.

These various types of retail activities may be operationally defined in terms of retail sales area, number of retail outlets and street frontage. Since data is gathered at the block level, the variable street frontage is included as an attempt to take into consideration this particular requisite of the retail function. For stores included within the Place de Ville complex, boutique frontage is considered equivalent to street frontage.

A factorial analysis of the retail data was undertaken in order to establish relevant relationships. Twenty-six blocks which did not contain any retail activity in 1971 were eliminated from this analysis. The factor structure (table 19) fails to identify associations between types of activities since the six factors correspond to the six types of activities included within the data set. The factors do reveal, however, a very strong association between number of firms, retail area and street frontage for each category specified. The relationships between the

TABLE 19

RETAIL ACTIVITY 1971: ROTATED FACTOR MATRIX

Factor Number		1	2	3	4	5	6
Eigenvalue		2.8	2.7	2.7	2.3	2.3	2.3
Percent of Total Variance		15.7	15.2	15.2	13.1	13.0	12.9
Variable	Commu-nality	Apparel and Acces-sories	Food Stores	General Merch.	Auto Sales and Acces-sories	Hardw. Furn. Home Furn.	Other Retail
67. Stores: Food	.86		.925				
68. Stores: Gen. Merch.	.84			.872			
69. Stores: Auto.	.66				-.789		
70. Stores: Apparel	.91	.901					
71. Stores: Hardw.	.70					.752	
72. Stores: Other Ret.	.71	.421					-.681
73. Front: Food	.94		.965				
74. Front: Gen. Merch.	.97			.969			
75. Front: Auto.	.97				-.976		
76. Front: Apparel	.90	.897					
77. Front: Hardw.	.93					.949	
78. Front: Other Ret.	.85						-.910
79. Area: Food	.87		.914				
80. Area: Gen. Merch.	.86			.910			
81. Area: Auto.	.72				-.843		
82. Area: Apparel	.93	.903					
83. Area: Hardw.	.78					.883	
84. Area: Other Ret.	.89						-.937

selected retail activities must be sought within the correlation matrix; underlined correlations in table 20 are those indicating a relationship between retail activities.

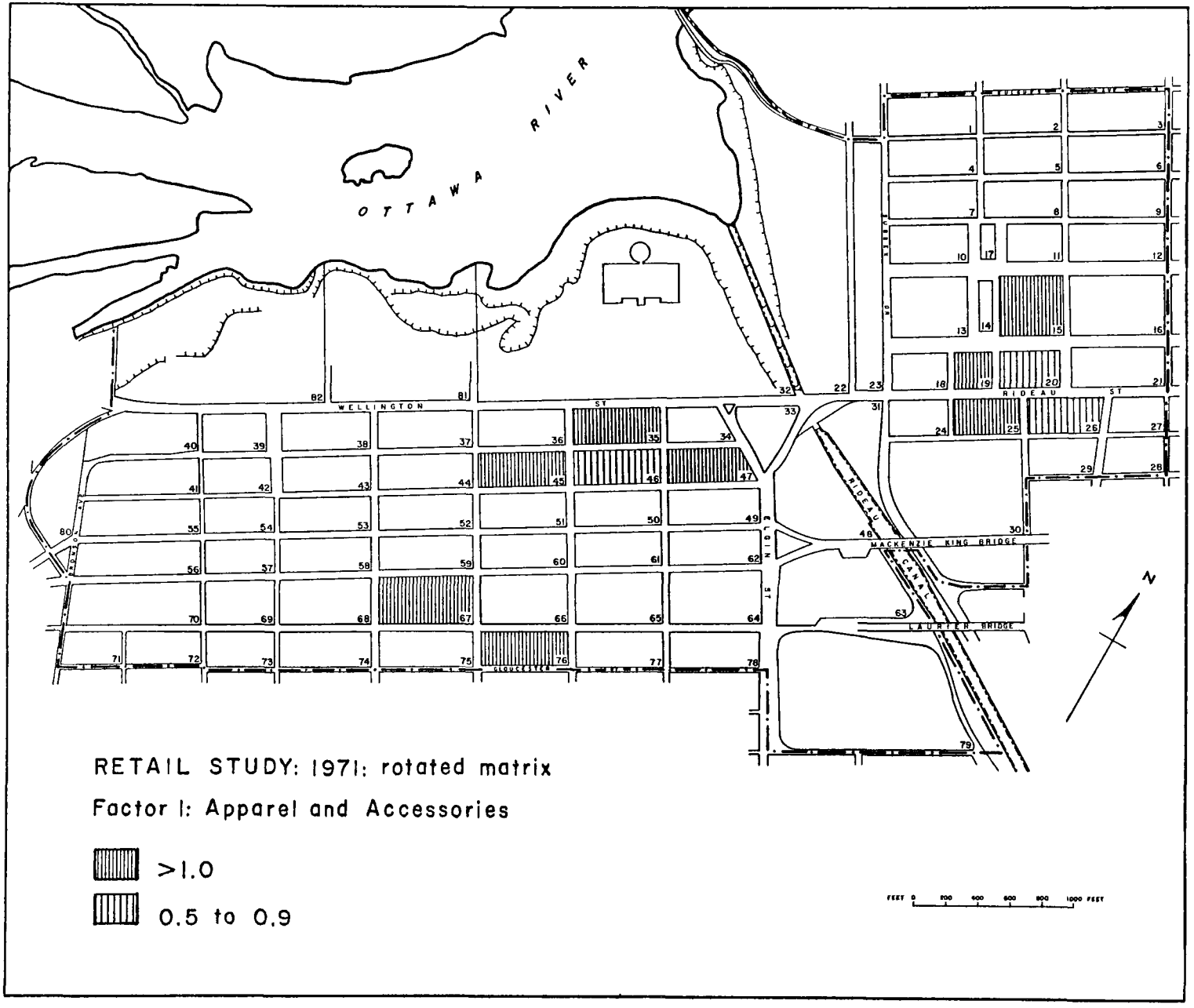
The expected relationship between the variables identifying the sale of 'general merchandise' and 'apparel and accessories' is verified. The factor score distribution for the components identifying these two activities (maps 43 and 45) clearly distinguishes the Rideau and Sparks commercial areas. The Apparel and Accessories component further specifies a few blocks along Bank street.

Relationships between activities is otherwise limited to 'number of stores'. In this context a moderate relationship is indicated between 'apparel' and 'other retail' stores (.56); a weak relationship is apparent between 'hardware' and 'apparel' stores (.36) and 'hardware' and 'other retail' outlets' (.34). 'Other retail' stores are found both within the Sparks street shopping district and that section of Lower Town north of Rideau street (map 48); this area is further characterized by a large number of 'hardware' (map 47) and 'food' stores. The correlations, and more specifically the spatial distribution of these activities, appear to distinguish the general character of commercial activities in Lower Town from that of the business section of Upper Town. The retail classification does not allow further qualification. Sparks street for example includes boutiques specializing in the sale of high quality and rare goods; Lower Town, on the other hand, caters to more domestic needs. The type of goods offered explains to some extent why sales are increasing in the Sparks street area in recent years but declining in Lower Town.

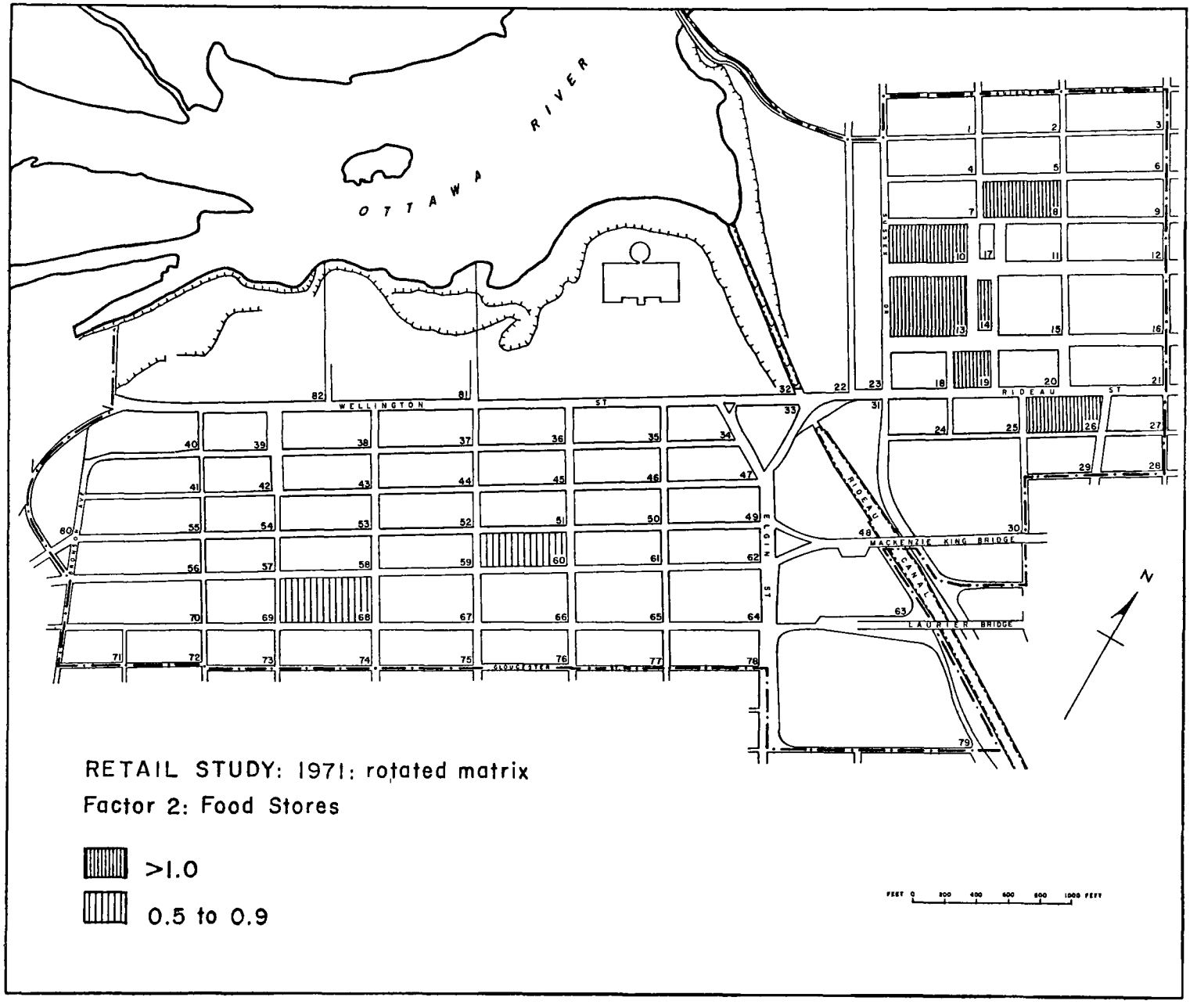
TABLE 20

RETAIL ACTIVITY 1971: CORRELATION MATRIX

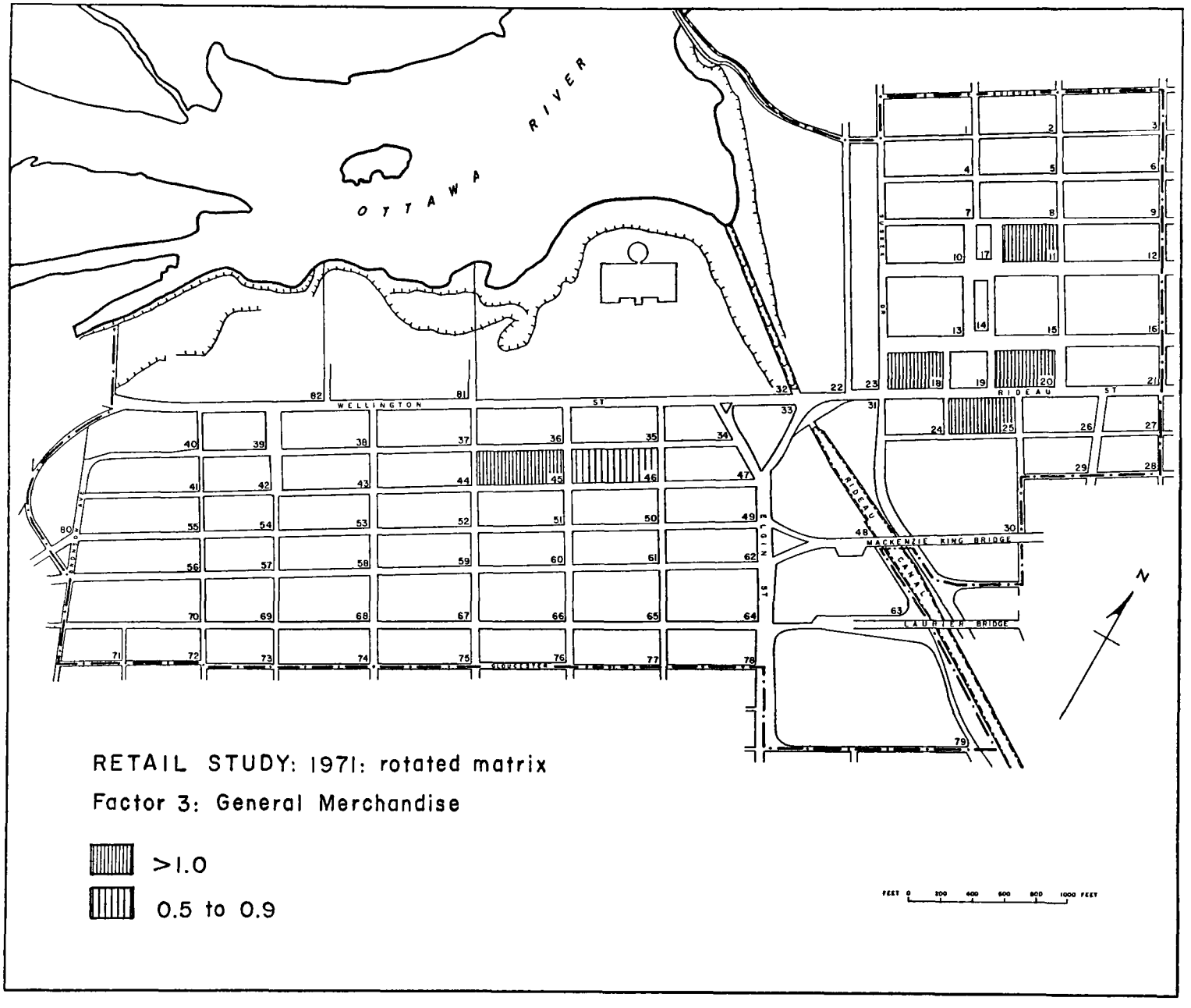
		67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
67.	Stores: Food	1.00																	
68.	Stores: Gen. Merch.		1.00																
69.	Stores: Auto.			1.00															
70.	Stores: Apparel		.33		1.00														
71.	Stores: Hardw.				.36	1.00													
72.	Stores: Other Ret.				.56	.33	1.00												
73.	Front: Food	.87						1.00											
74.	Front: Gen. Merch.		.88						1.00										
75.	Front: Auto.			.76						1.00									
76.	Front: Apparel		.44		.83		.31		.34		1.00								
77.	Front: Hardw.					.74						1.00							
78.	Front: Other Ret.						.56						1.00						
79.	Area: Food	.76						.88						1.00					
80.	Area: Gen. Merch.		.69						.90						1.00				
81.	Area: Auto.			.37						.83						1.00			
82.	Area: Apparel		.49		.87		.36		.41		.93				.33		1.00		
83.	Area: Hardw.					.45						.79						1.00	
84.	Area: Other Ret.				.36		.59						.82						1.00


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
RIDEAU CANAL
ELGIN ST
GLOUCESTER
N
RETAIL STUDY: 1971: rotated matrix
Factor I: Apparel and Accessories
>1.0
0.5 to 0.9
FEET 0 200 400 600 800 1000 FEET

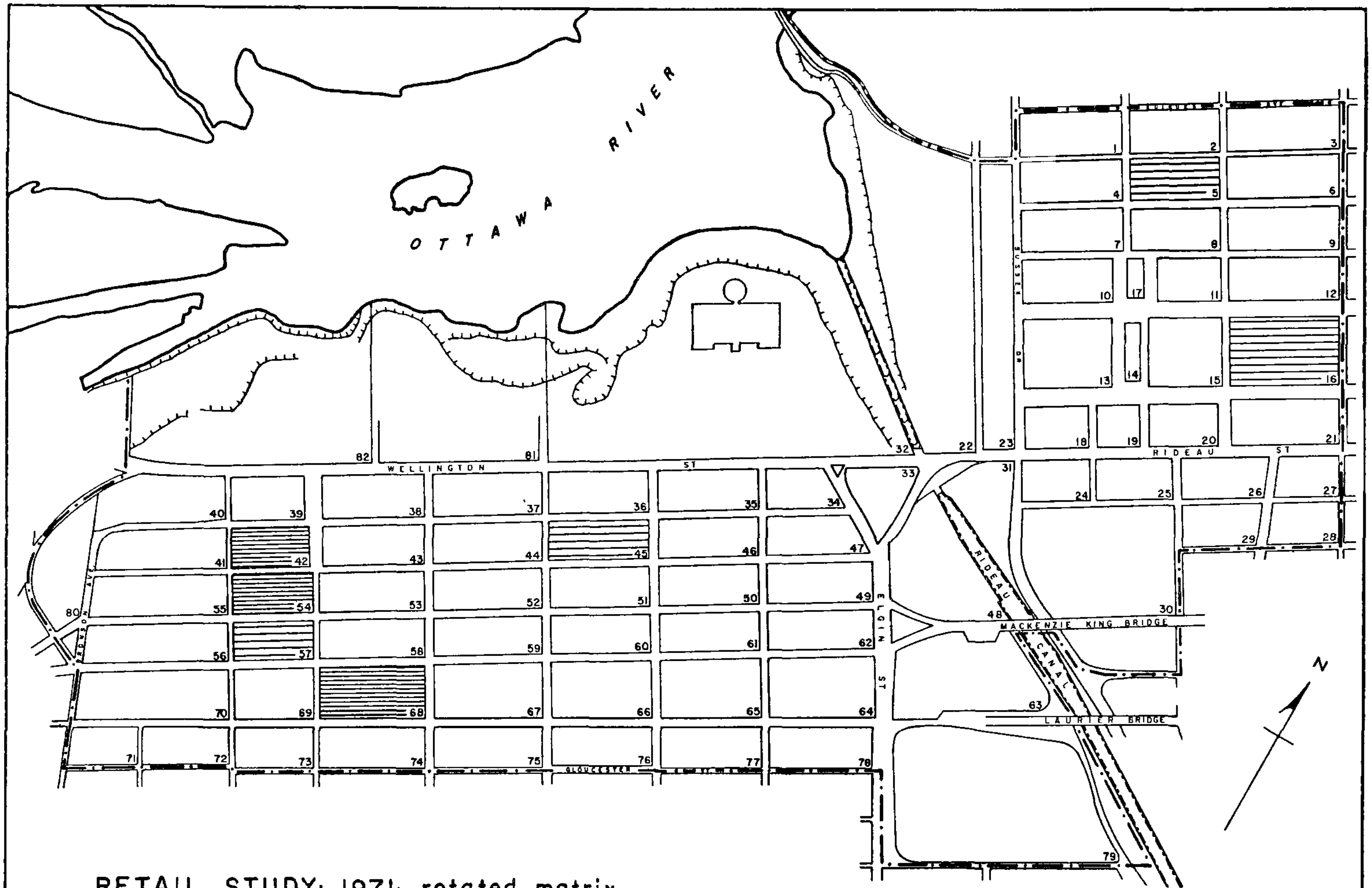
MAP 43


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
MACKENZIE KING BRIDGE
RIDEAU CANAL
LAURIER BRIDGE
MAIN ST
GLOUCESTER
N
RETAIL STUDY: 1971: rotated matrix
Factor 2: Food Stores
>1.0
0.5 to 0.9
FEET 0 200 400 600 800 1000 FEET

MAP 44


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
MACKENZIE KING BRIDGE
CANAL
LAURIER BRIDGE
N
RETAIL STUDY: 1971: rotated matrix
Factor 3: General Merchandise
>1.0
0.5 to 0.9
FEET 0 200 400 600 800 1000 FEET

MAP 45



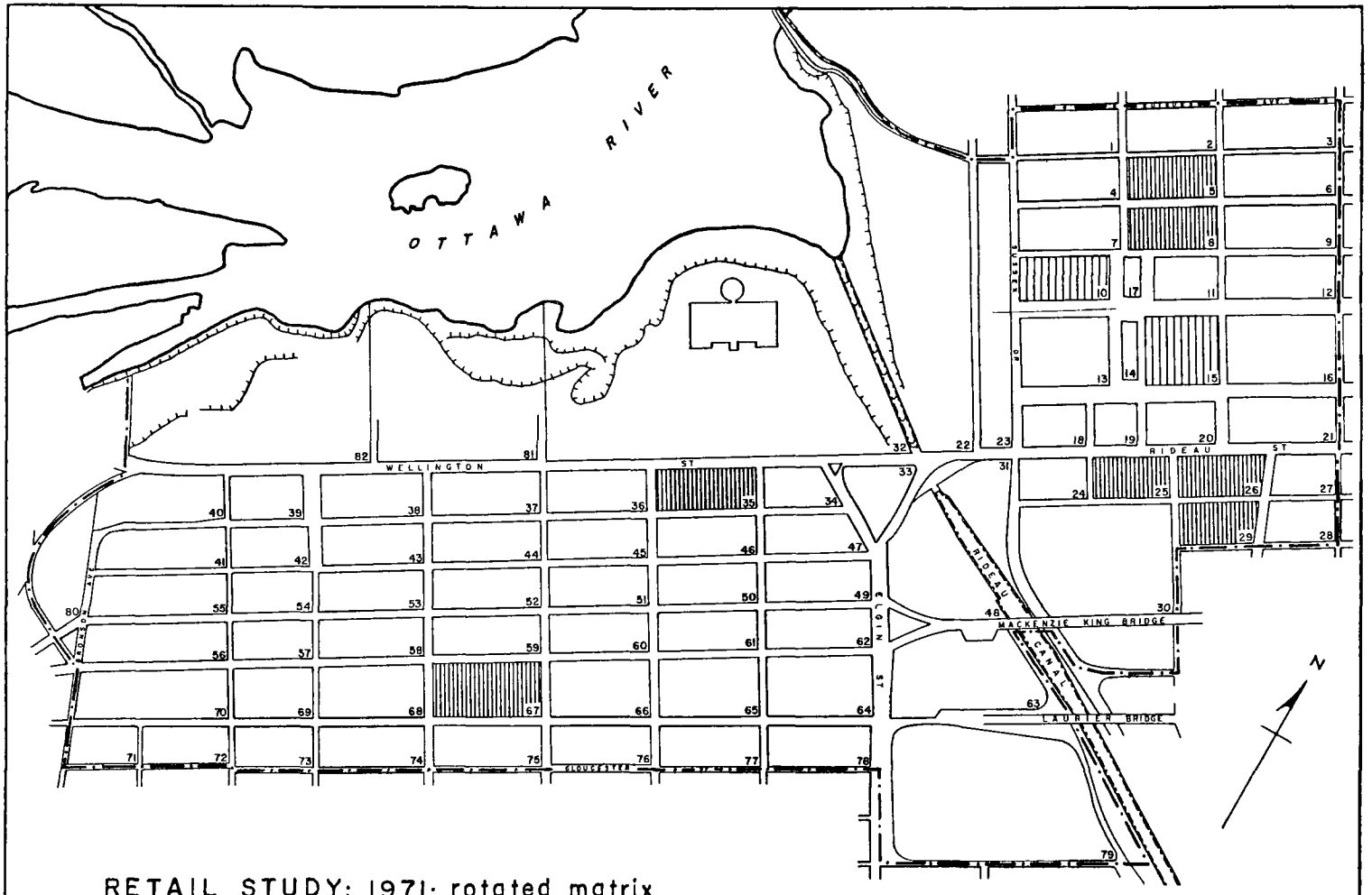
RETAIL STUDY: 1971: rotated matrix

Factor 4: Automotive Sales and Accessories

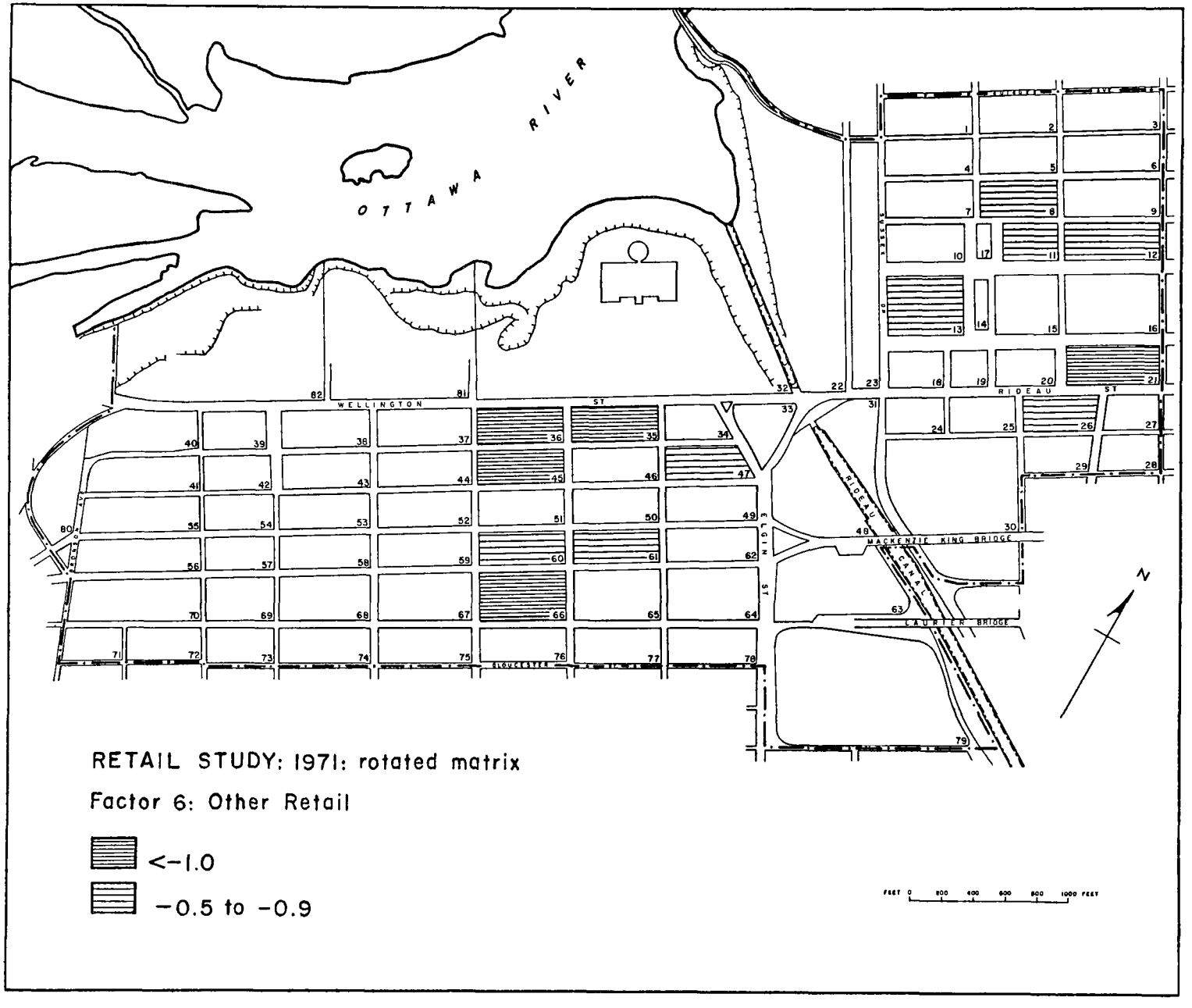
<-1.0

−0.5 to −0.9

MAP 46


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
ELGIN ST
RIDEAU CANAL
MACKENZIE KING BRIDGE
LAURIER BRIDGE
GLOUCESTER
RETAIL STUDY: 1971: rotated matrix
Factor 5: Hardware, Furniture, Home Furnishings
>1.0
0.5 to 0.9
FEET 0 200 400 600 800 1000 FEET

MAP 47


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
ELGIN ST
RIDEAU
MACKENZIE KING BRIDGE
CANAL
LAURIER BRIDGE
GLOUCESTER
RETAIL STUDY: 1971: rotated matrix
Factor 6: Other Retail
<-1.0
-0.5 to -0.9
FEET 0 200 400 600 800 1000 FEET

MAP 48

'Automotive sales and accessories' and 'food stores' are not associated with any of the selected retail activities. The absence of strong correlations for 'food stores' may result from the variable definition. Nevertheless, the component clearly outlines the market area of Lower Town, the focal point of which is block 14, where food stores are varied and numerous (map 44). The distribution of 'autonotive sales and accessories' is clearly peripheral to the business and commercial districts with the exception of block 45 which includes a small gas bar operated by a car rental service (map 46).

The strong association between variables measuring the importance of each retail activity suggests that they may in effect measure the same phenomenon. The nature of these relationships may be further assessed by means of the linear repression model and the analysis of regression residuals. In the first analysis, the regression model is used to verify the assumption that 'retail sales area' may be assessed from 'frontage' data:

$$Y = a + bX$$

where Y = total retail sales area

X = total retail frontage

Since the data are standardized, the equation becomes:

$$Y = .0 + .76X$$

From table 21 it may be noted that an association between the two variables does exist for the area under study. The degree of association is moderate however as only 59 percent of the variation in retail sales area is accounted for by the independent variable. Although the data in this analysis are treated as population data, the

TABLE 21

RELATIONSHIP BETWEEN RETAIL SALES

AREA AND RETAIL FRONTAGE

$r = .765$

$r^2 = .586$

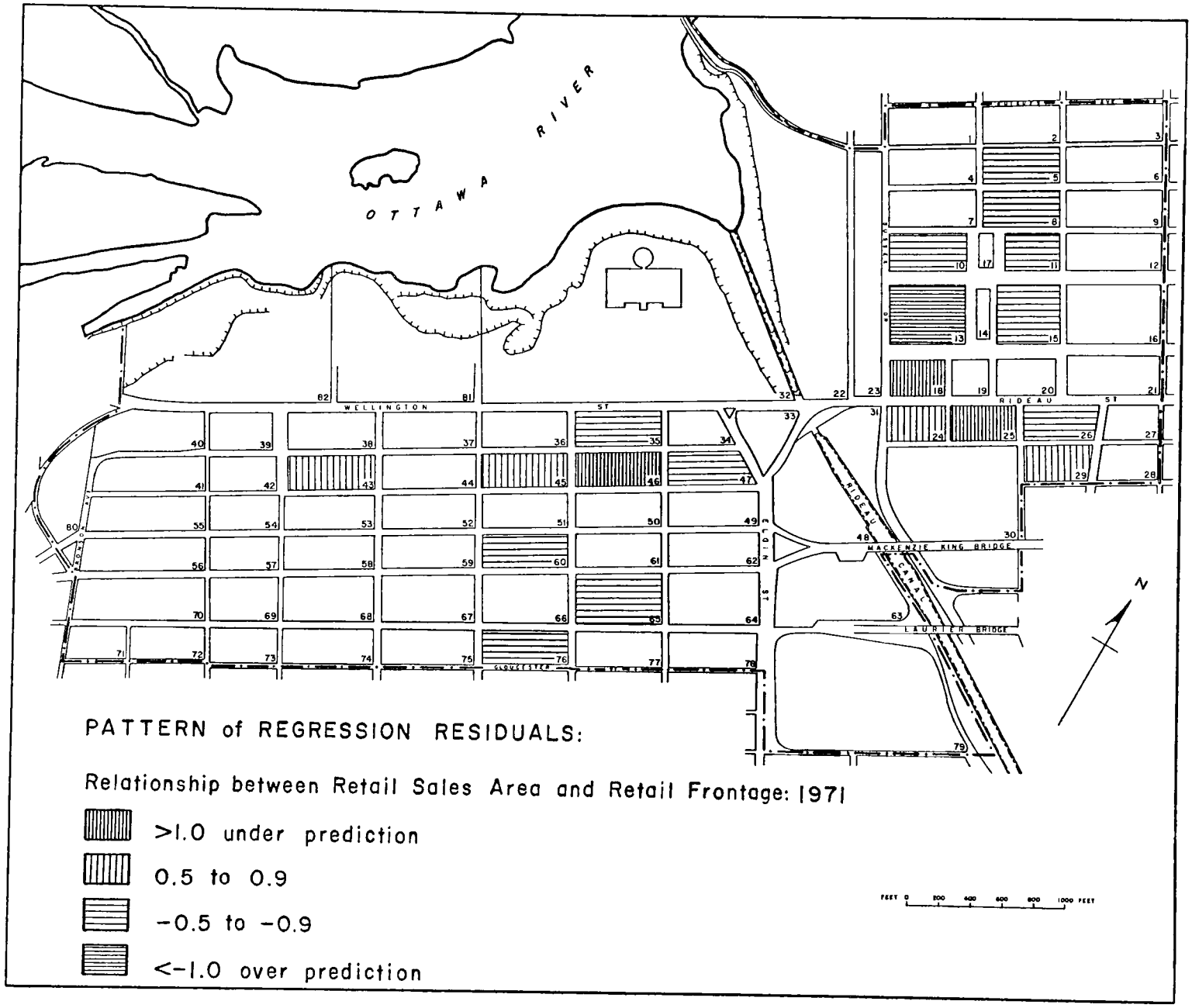
$t = 10.650^*$

* The value of t at the 0.01 level with 80 degrees of freedom is 2.64.

t-test is included in table 21 as an estimate of the significance of the regression coefficient.

The cartography of regression residuals offers further insight into the character of central area retail activity. Map 49 indicates that part of the Place de Ville complex, the Sparks and Rideau street areas are under predicted by the equation. The under-estimation emphasizes the importance of commercial space; these results are not altogether surprising since most of these blocks include the larger general merchandise stores. Over prediction appears more widespread in Lower Town but also occurs along Sparks, Rideau and Bank streets. The residuals nevertheless suggest that under prediction is likely to occur along major commercial streets. The correlation matrix has demonstrated that the strength of this relationship varies fron one type of retail activity to another; an analysis at the outlet level, as opposed to the aggregate block level, would undoubtedly yield more conclusive results.

A second regression analysis verifies to what extent the


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
ALOEAU
MACKENZIE KING BRIDGE
CANAL
LAURIER BRIDGE
N
PATTERN of REGRESSION RESIDUALS:
Relationship between Retail Sales Area and Retail Frontage: 1971
>1.0 under prediction
0.5 to 0.9
-0.5 to -0.9
<-1.0 over prediction
FEET 0 200 400 600 800 1000 FEET

MAP 49

importance of 'retail sales area' may be assessed by the 'number of retail outlets':

$$Y = a + bX$$

where Y = total retail sales area

X = total number of retail outlets

The regression equation becomes:

$$Y = .0 + .47X$$

TABLE 22

RELATIONSHIP BETWEEN RETAIL SALES AREA AND NUMBER OF RETAIL OUTLETS

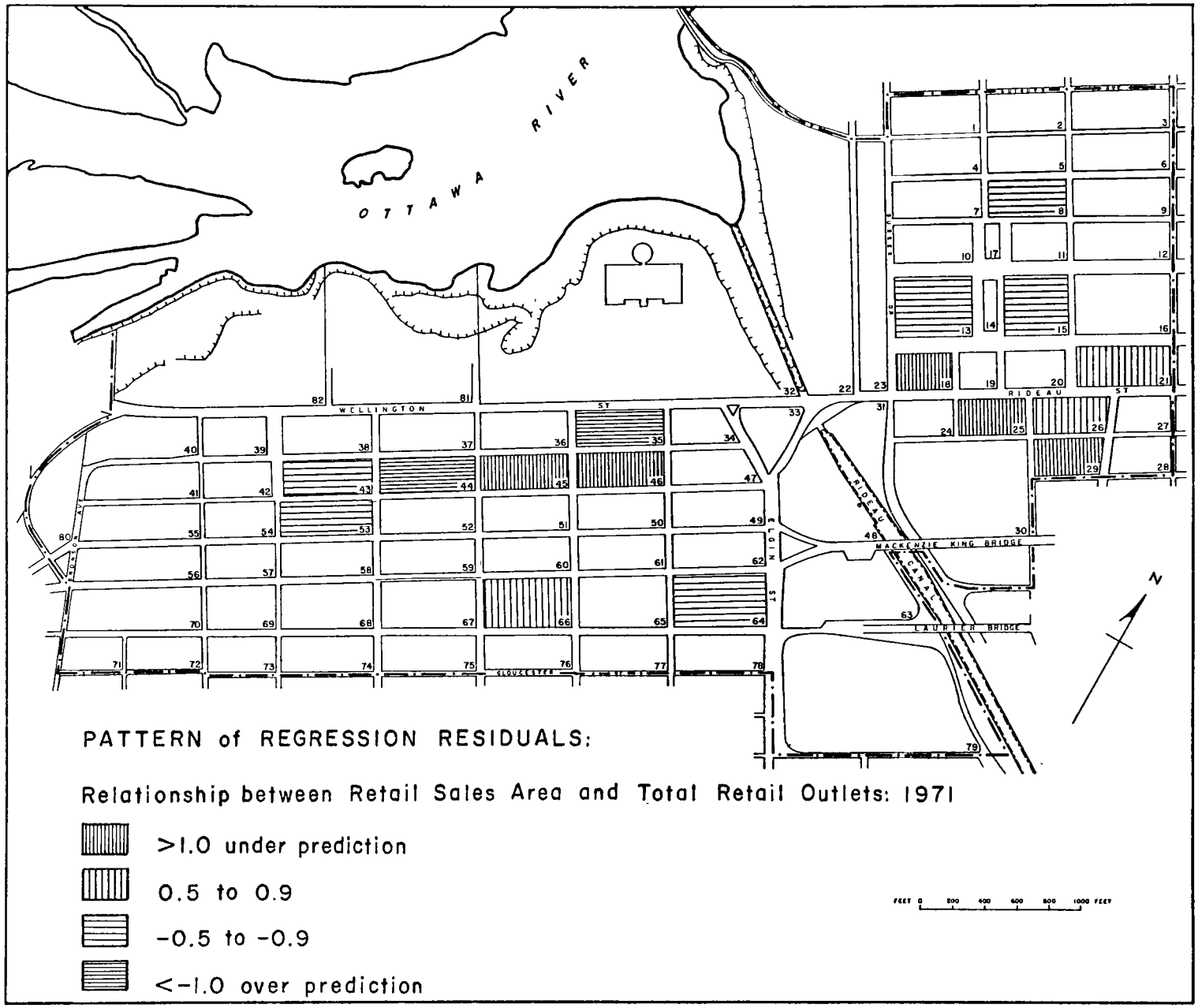
$r = .478$

$r^2 = .228$

$t = 4.871^*$

* The value of t at the 0.01 level with 80 degrees of freedom is 2.64.

The correspondence in this case is much weaker as table 22 indicates; only 22 percent of the variation in retail sales area is accounted for although the t-test for the regression coefficient is significant at the 0.01 level. The pattern of regression residuals (map 50) is reminiscent of that portrayed by the previous analysis. The distribution is perhaps more specific however, since under prediction occurs decidely along commercial arteries and over prediction, with the exception of block 35, occurs outside these major commercial zones. As King points out, the regression model assumes that residuals are normally distributed and


OTTAWA RIVER
WELLINGTON ST
RIDEAU ST
ELGIN ST
MACKENZIE KING BRIDGE
LAURIER BRIDGE
GLOUCESTER
PATTERN of REGRESSION RESIDUALS:
Relationship between Retail Sales Area and Total Retail Outlets: 1971
>1.0 under prediction
0.5 to 0.9
-0.5 to -0.9
<-1.0 over prediction
FEET 0 200 400 600 800 1000 FEET

MAP 50

independent, so that: "If the residuals do show a strong pattern, then it may be that the explanatory model being considered is not a very powerful one since the variables in it are not accounting fully for the spatial variation in the dependent variable." (L. King, 1969) In this respect, the pattern of regression residuals confirms the low explanatory power computed by the coefficient of determination (r^2). Over prediction for blocks 43 and 53 emphasizes the character of commercial activity in the Place de Ville underground mall where numerous but usually small boutiques offer a wide variety of goods.

The retail study indicates that the type of retail activity and to some extent the 'number of retail outlets' are the better estimators of spatial differentiation within the study area. In other words, a broader variety of retail types would allow a better distinction of retail zones. However, the broadning of the retail classification increases the importance of non-occurrence, or zero values, so that the relationships established in the correlation matrix become poor estimators of the visible landscape.[1]

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[1]Appendix B includes the retail data correlation matrix computed for 82 observations. As previously indicated 26 spatial units have no retail activity in 1971. The inclusion within the data set of these observations with zero values considerably transforms the values in the correlation matrix.

CHAPTER VI

COMPREHENSIVE CENTRAL AREA ANALYSIS

The previous analyses have directed the choice of variables for the comprehensive analysis. Variables identifying municipal and institutional occupation have been eliminated from the analysis because of their infrequent occurrence within the study area; activities such as entertainment and manufacturing were withdrawn for the same reason. All types of office space, other than government office space, were grouped.

Four variables are added to the analysis. 'Parks' and 'vacant open space' complete the land use classification for 1971, whereas 'employees' adds to the functional character of the central area. Construction data, although available for only a short time span (1969-1972), attempts to incorporate a dynamic element into an analysis locked in a given temporal framework.

The comprehensive analysis clearly identifies the functional core of the Ottawa CBD. This core area is defined by structural intensity and pertinent land use associations. The analysis indicates, however, that land ownership is not a decisive element of spatial differentiation within the central area. A notable exception is perhaps the strategic distribution of federal land holdings. Federal land acquisitions have resulted from a need to expand government facilities but can also be incorporated within a broader planning scheme geared at building a show-place commensurate with Ottawa's role as the nation's capital. Large

federal properties therefore partially encompass the downtown functional core, although they may more aptly be considered a part of that core. Commercial and private properties, on the other hand, are found both in the functional core, and in the marginal blocks incorporated within the study area. As might be expected, land value and structural stock are the keener differentiating elements; the subordinate position of private ownership in this respect is nevertheless manifest.

The analysis isolates seven factors which account for 83 percent of the variation in the data (table 23). The first factor, which may be termed Functional Intensity, accounts for 18 percent of the variance. The component associates the structural variables with 'employees', 'government office space', 'land value' and 'value of commercial property'. The importance on the factor of commercial land value as opposed to federal land value emphasizes the close relationship between commercial enterprise and government activity. The strong loading of both construction variables verifies the dynamic character of the Ottawa central business district. The distribution of factor scores largely coincides with the Intensity of Occupation map for 1971 (map 26).[1]

The second component, which accounts for 17 percent of the variance, specifies the importance and character of federal land holdings. The variables emphasize the size of these properties and the importance of open space for parking as well as for recreational purposes. The

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[1] A table of factor scores indicating those values above the ±0.5 chosen level of interpretation are indicated in Appendix C, Comprehensive Central Area Analysis: Rotated Factor Scores.

TABLE 23

COMPREHENSIVE CENTRAL AREA ANALYSIS 1971:
ROTATED FACTOR MATRIX

Factor Number		1	2	3	4	5	6	7
Eigenvalue		5.2	5.0	4.4	3.3	2.3	2.2	1.5
Percent of Total Variance		18.0	17.2	15.2	11.5	8.0	7.6	5.2
Variable	Communality	Functional Intensity	Federal Ownership	Block Fragmentation	High Value Commercial Ownership	Retail vs Residential	High Value Private Ownership	Open vs Enclosed Parking
1. Tot. Owners	.88			.904				
2. Tot. Properties	.85			.844				
3. Tot. Owner Occupied	.74			.789				
10. Size: Private	.64						.758	
11. Size: Commercial	.93				-.944			
14. Size: Federal	.95		-.949					
16. Value: Private	.84						.888	
17. Value: Commercial	.86	.486			-.741			
20. Value: Federal	.94		-.908					
21. Block Size	.97		-.857		-.326			.338
23. Tot. Ass. Value	.94	.500	-.793					
91. Parks	.88		-.633		-.628			
92. Vacant Open Space	.79		-.855					
85. Tot. Ret. Outlets	.81					.828		
86. Tot. Ret. Frontage	.82					.883		
29. Tot. Buildings	.76			.845				
31. Storeys Above Ground	.90	.794		.332				
50. Residential	.66			.671		-.369		
51. Residential Commercial	.93				-.925			
52. Government	.86	.806						
63. Open Parking	.80		-.393					.738
64. Enclosed Parking	.65	.588						-.456
32. Tot. Floor Space	.90	.814			-.375			
22. Lot Coverage	.78	.494	-.582					.391
87. Employees	.93	.863						
65. Population: 1971	.81			.757		-.408		
88. Value Constr. -100	.61	.605					.414	
89. Value Constr. +100	.87	.744			-.464			
90. Other Office	.64	.377				.332	.612	

strategic location of these properties offers an ideal setting for green spaces in close proximity to the downtown core. The Rideau Canal obviously acts as a barrier to the expansion of CBD activities; but the large properties along the canal also hinder eastward expansion. The combination of these elements has encouraged the revitalization of the existing district and new developments to occur south and west of the CBD core (map 41: Building Construction in the Ottawa Central Area 1960 to 1970).

The third factor, on the other hand, defines Block Fragmentation which is associated with residential land use. Residential land use does not necessarily mean private ownership; most blocks characterized by parcelling and residential land use also include commercial ownership.[1] Although an association might be expected between variables defining private ownership and those pertaining to residential land use, no significant relationship is specified in the correlation matrix (table 24). The evolution of land ownership for those blocks located at the periphery of the CBD is an indication of the changing character of these areas. This change, particularly in the Upper Town section, is in turn undoubtedly related to the growth of the functional district.

The fourth component associates commercial ownership with 'parks' and 'hotels'. The importance of park areas on the component does not, however, correspond with the reality of the central area landscape; only

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[1] Blocks 4, 6, 71 and 72, specified at the 0.5 factor score level in Appendix C, do not include commercial ownership in 1971. All blocks include private ownership, however.

TABLE 24

COMPREHENSIVE CENTRAL AREA ANALYSIS 1971:
CORRELATION MATRIX

		1	2	3	10	11	14	16	17	20	21	23	91	92	85	86	29	31	50	51	52	63	64	32	22	87	65	88	89	90
1.	Tot. Owners	1.00																												
2.	Tot. Properties	.81	1.00																											
3.	Tot. Owner Occupied	.82	.72	1.00																										
10.	Size: Private				1.00																									
11.	Size: Commercial					1.00																								
14.	Size: Federal		-.34				1.00																							
16.	Value: Private					.58		1.00																						
17.	Value: Commercial								1.00																					
20.	Value: Federal		-.32				.83			1.00																				
21.	Block Size		-.32				.92			.64	1.00																			
23.	Tot. Ass. Value	-.30	-.42				.74			.82	.66	1.00																		
91.	Parks		-.32				.69			.45	.77	.43	1.00																	
92.	Vacant Open Space						.86			.71	.82	.66	.44	1.00																
85.	Tot. Ret. Outlets		.33												1.00															
86.	Tot. Ret. Frontage	.30	.31												.76	1.00														
29.	Tot. Buildings	.77	.75	.65													1.00													
31.	Storeys Above Ground							.35	.45						.46		.34	1.00												
50.	Residential		.47			.32						-.32					.41		1.00											
51.	Residential Commercial								.73		.39		.60					.30		1.00										
52.	Government		-.34				.30		.37		.32	.55		.31				.46			1.00									
63.	Open Parking						.48				.63	.30		.55							.42	1.00								
64.	Enclosed Parking								.56			.34						.35		.31	.33		1.00							
32.	Tot. Floor Space								.58		.33	.60						.67		.58	.75		.43	1.00						
22.	Lot Coverage						.56			.48	.59	.67		.47							.56	.57		.61	1.00					
87.	Tot. Employees		-.33					.38	.42			.63						.67	.36	.30	.82		.38	.83	.57	1.00				
65.	Population: 1971	.58	.57	.41								-.36					.56		.70		-.30			-.31		-.39	1.00			
88.	Value Constr. -100							.48				.39						.59			.34			.51		.67		1.00		
89.	Value Constr. +100								.77			.40						.64		.57	.54		.65	.73		.60		.47	1.00	
90.	Other Office																	.50						.41		.46		.48		1.00

block 22, which includes the Chateau Laurier and Major Hill Park, can be considered a full expression of the component. 'Value of construction greater than 100,000 dollars' is also associated with the factor, whereas, 'value of construction below 100,000 dollars' is related to High Value Private Ownership (factor 6). The construction variables emphasize the importance of commercial investment in central area development. Private ownership is also associated with 'other office'; the component however only accounts for 7.6 percent of the total variance. The private property is most often the size of a single lot within the study area or at least smaller than the average commercial property; there is little evidence pointing to lot consolidation previously associated with federal and commercial ownerships.

The fifth component, Retail Activity versus Residential Land Use, adds further differentiation between CBD and non-CBD activities within the study area. On the other hand, factor 7, Open versus Enclosed Parking, distinguishes between extensive and intensive land uses related to block dimension.

CHAPTER VII

CONCLUSION

The dynamic evolution of the Ottawa central area during the 1960-70 decade is closely linked to the city's economic base. The major catalyst is the strengthening of the city's administrative function which is, in turn, related to the post-war growth of the tertiary sector (and especially the administrative bureaucracy) in advanced economies.

The study of the Ottawa central area has outlined three distinct zones: the functional core of Upper Town corresponding to the central business district as defined by Murphy and Vance; a secondary functional district located in Lower Town where commercial activity predominates; and peripheral sectors mixing residential, commercial and institutional land uses found in the north-eastern and south-western sections of the study area. These three zones can be differentiated in terms of their functional activity and their structural stock.

The functional and structural characteristics of Upper Town have evolved considerably since the early 1960's. The vertical and horizontal expansion of CBD activities is the most direct expression of this evolution. These trends attest to the strengthening of the functional character of the Ottawa CBD. A more extensive study dealing with the growth and distribution of those activities defined as CBD-forming activities, however, would establish the relative importance of the CBD within the metropolitan functional framework.

Retail activity seems to have played a relatively minor role in the functional evolution of the central area. The character of the Sparks street commercial district has undergone modifications and now includes a greater number of successful specialized boutiques. But for the central area as a whole, retail sales and retail space have suffered significant relative declines. The future vitality of the commercial districts therefore appears to depend on the type and quality of goods offered as well as on the ability to adapt to a changing role within the broader context of retail activity in the metropolitan area.

The area east of the Rideau canal is characterized mainly by its commercial activity. The encroachment of retail activity into the Lower Town residential section and the character of this retail activity highlites characteristics traditionally attributed to transition zones at the periphery of CBDs (Griffin and Preston, 1966). During the 1960-70 decade this area has not participated in the growth trends which have so dramatically altered the skyline of Upper Town. The historical quality of Lower Town, however, has been increasingly emphasized by both the National Capital Commission and the municipality. Restoration and a low density profile are the benchmarks for future development. The undramatic evolution during the decade is most probably related to the slow return on investment associated with such an undertaking. The low rate of private and commercial investment in the area has left the burden of the initiative on local government agencies. This offers only a partial explanation, however, for the slow replacement or restitution of a generally decaying building stock. The proposed development plans for the upper Rideau street commercial section could provide the necessary

impetus for new developments in the Lower Town area.

The changing character of the western peripheral section of the study area is undoubtedly a direct response to the dynamic growth of the functional district. Poor quality housing and extensive land uses are slowly being replaced by higher density apartment buildings interspersed with low density tertiary activities. The transitional character of the area is revealed by the gaping holes left by an indiscriminate demolition hammer and by a startling juxtaposition of the old and the new.

The study has also indicated that distinct structural characteristics may be associated with the three major land owners in the central area, at least for that area defined as the functional district. The evolution of land ownership appears closely linked to the process of lot consolidation and central area development. In this context, commercial ownership is squeezing out private interests in the central area such that commercial ownership within the functional core is associated with growth and structural intensity. Through this dynamic process of change, the complexity of land ownership and the intensity of block fragmentation, hidden dimensions visibly apparent by the land use mix, become distinguishing features of blocks located at the periphery of the functional core. The category 'commercial ownership' is, however, broadly defined. Further investigation is needed to determine a more realistic ownership base and therefore the origin of capital interests involved in central area development.

Federal ownership remains the most obvious and dominating feature of the central area landscape. The federal profile can be extended with relative ease through expropriation and further enhanced by restrictive

zoning by-laws. The expansion of federal ownership and the related functional intensity has contributed significantly to the growth and diversification of other tertiary activities in the central area. This relationship needs further verification, however, as other elements, such as population growth, also contribute to the diversification of urban activities. The role of Ottawa as the nation's capital is nevertheless a unique case within the Canadian urban system. The degree of uniqueness or general applicability of the Ottawa central area experience should therefore be evaluated.

Component analysis is generally described as a descriptive technique. The most rewarding aspect of the application of this technique is the discovery of relationships not always apparent in the course of data manipulation. The formulated relationships nevertheless remain conditioned by the mathematical constraints of the component model. The relationships established by the components must therefore be further evaluated by the correlation coefficients and, when necessary, by the original data. Results are not altogether satisfactory, for example, when dealing with data which is only sparsely distributed among the units of observation. In this respect, land use data poses specific problems such that increasing detail defies generalization. Several correlations between types of activities can be explained by chance joint occurrences among the units of observation and more importantly, by their non occurrence; in other words, the number of zeros included in the original data matrix can strongly influence the correlations and subsequent factor loadings. It therefore becomes apparent that very few factors

may be considered an expression of the real landscape.

The Murphy and Vance technique may be criticized for an a priori distinction of CBD-forming activities; the use of principal components analysis for analyzing land use data may be criticized for an a posteriori elimination of activities for which relationships and distributions may not be successfully evaluated because of their limited occurrences within the units of observation. The character of these activities, their evolution, are nevertheless of significant importance to the understanding of growth and change in CBDs and their transition zones.

Principal components analysis also allows for the spatial analysis of relationships through the cartography of factor scores. Factor score distributions, however, are influenced by extreme values. It therefore becomes difficult to establish the relevance of spatial distributions if such distributions are largely influenced by the range of values included in the data set. A high factor score for one or several units of observation is sometimes explained by the high value of a single variable for that observation. This variable may, or may not, play a significant role in the component definition. In such instances, the factor score is not an accurate estimate, for a particular unit of observation, of the relationship expressed by the component.

When dealing with land use data, extreme values are only one of the elements which affect the distribution of factor scores. Urban land uses can be assessed not only in terms of their volume or quantity which relate to the intensity of use, but most importantly in terms of their presence or absence within a given area. This is specifically a question of spatial distribution; the presence of certain activities within the

central area is closely linked to the presence of other activities so that land use associations must be evaluated in terms of spatial relationships. This is where the application of principal components analysis to the study of land use fails most conspicuously. The technique evaluates relationships within the units of observation, but ignores relationships between observations; given the possible number of land uses within each unit of observation, the relationships that the technique can evaluate are limited. This explains why greater detail results in the definition of components by essentially a single variable. The factor score distribution, which is meant to express the spatial importance of a factor, is in essence a distortion of the traditional land use map. More emphatically, the factor score distribution reveals a statistical spatial relationship which does not exist in the real landscape.

Log transformation or a modified unit of measurement may minimize the influence of large values to some extent; but increased data transformation accentuates the error factor and may also lead to an unwarranted distortion of actual phenomena. There is no evidence that these added precautions can lead to anything other than the broadest level of generalization. The conclusions which can be drawn from such an analysis are therefore limited.

It must be specified, however, that the size of the unit of observation is not necessarily a handicap; the structural analysis gives excellent results. In this case, values are registered for all blocks, with the exception of those devoid of construction, so that spurious relationships are avoided. The retail study, on the other hand, gives poor results. The cursory classification of retail activities into six

classes is grossly inadequate; linkages between types of retail activity are important within the downtown area so that greater detail is necessary in order to evaluate the character and evolution of retail concentration. Since retail activity is more specifically related to block face, the aggregate block level as a unit of observation also proves unsatisfactory.

The Pinchemel approach is only one of several approaches to the study of geographical landscapes. As any other descriptive approach, it emphasizes the study of relationships which,in turn,may lead to generalizations and a more knowledgeable interpretation of the processes involved in structuring the visible landscape.

The study remains a descriptive analysis; no attempt is made to fully evaluate the dynamic forces involved in central area development. Although the extent of the study area is limited, and the structural and land use analyses cover only a short time span, some probing questions are raised concerning the factors generating change in the Ottawa central area. Land ownership poses questions about the origin of capital investment required in central area development. Whereas federal expropriation may be considered an external stimulus, it can be hypothesized that the evolution of other types of land ownership, which generate changes in land use or structural stock, are in effect precipitated by other factors of change. In this context, the importance of municipal and federal planning policy in directing growth and in dictating structural stock should not be underestimated. These policies have also changed through time in response to pressures exerted by developers so that cause and effect in policy making is not easily distinguished.

The growing intensity of land use and the disappearance of extensive land uses confirm the general evolution of central areas; but the relative role of attractive forces, the selective process by which activities are either attracted to the central area or to other functional districts within the city offers an interesting field of investigation. Another question which merits attention is that of limits to growth, as advanced technology creates new thresholds of diseconomies. In the early 1970's the Ottawa central area showed little sign of having reached such a threshold. But perhaps it had reached a previous threshold and recent developments may,in part, be an adaptive response to cumulative constraints. The city as such has shown a greater capacity to innovate than most cities of its size. Here again the importance of the federal presence, as investor and guarantor,has been significant.

The quantitative analysis cannot account for the full range of elements which characterize the central area. Obviously, the Ottawa central area is not solelydefined by its functional district. The functional core outlines a very distinct skyline, but it is the diversity of functions, activities, spaces and linkages which give the downtown its unique charm and character. The following indicate a few examples of such non-quantifiable elements: the architecture of the turn-of-the-century buildings; the green spaces flanking the Rideau canal and adorning Parliament Hill; the diverse atmospheres created by the market place and the Sparks street mall; the historical and intimate quality of Lower Town; the face-lift given to the old Union Station which now serves as a conference centre; and the symbols of cultural heritage which represent the National Arts Centre and the National Arts Gallery.

APPENDIX A

VARIABLES AND VARIABLE DESCRIPTIONS

VARIABLES AND VARIABLE DESCRIPTIONS

The data for this study were obtained from a number of sources. Property size, value and ownership information for 1971 was tabulated from Municipal Assessment Records. To ascertain that all properties were recorded and assigned to the correct block, the 976 surveyed properties were first plotted on cadastral plans showing lot boundaries. These plans were provided by the Ottawa Engineering Department, Legal Surveys Branch. The data were then aggregated at the block level.

Land use and building stock data were compiled from surveys carried out by the Ottawa Municipal Planning Branch. A first survey for which data sheets were entitled Downtown Floor Use Survey provided the necessary information for 1961. The 1971 data were tabulated from two sources: data sheets entitled City of Ottawa Land Use Information, 1972, and Ottawa Planning Data - by Block, 1971-72. This latter information was further controlled by systematic field checks. Value of construction was tabulated from Construction and Demolition Permits records for 1969-72, also obtained from the Ottawa Municipal Planning Branch. Since a permit issue does not guarantee construction, this information had to be verified by field checks. Where excavation permits over 100,000dollars were issued, this information was accepted in lieu of the construction permit where the latter had not as yet been requested or approved.

Information pertaining to retail frontage and retail area by type

activity was obtained from a 1970 Retail Area Inventory carried out by the Regional Municipality of Ottawa-Carleton, Planning Division. This information was updated for every block so that omissions and changes could be recorded for 1971. The retail categories were grouped into the six Retail Trade by Kind of Business classes reported by the Census.

Parking information was updated from National Capital Commission data sheets entitled Parking Survey: Ottawa Central, 1969. Federal government floor space data were obtained from the Planning and Rssources Inventory Section, Ottawa Accomodation.

TABLE 25

VARIABLES AND VARIABLE DESCRIPTIONS

No.	Variable	Variable Description
1.	Tot. Owners	Total number of owners per block
2.	Tot. Properties	Total number of properties per block
3.	Tot. Owner Occupied	Total number of properties per block occupied by the owner: private, commercial, federal etc...
4.	No. of Properties: Private	Number of properties per block: private ownership
5.	No. of Properties: Commercial	Number of properties per block: commercial ownership
6.	No. of Properties: Institutional	Number of properties per block: institutional ownership
7.	No. of Properties: Municipal	Number of properties per block: municipal ownership
8.	No. of Properties: Federal	Number of properties per block: federal ownership
9.	Average Size of Property	Average size of properties per block
10.	Size: Private	Average size of properties per block: private ownership
11.	Size: Commercial	Average size of properties per block: commercial ownership
12.	Size: Institutional	Average size of properties per block: institutional ownership
13.	Size: Municipal	Average size of properties per block: municipal ownership

TABLE 25--Continued

14.	Size: Federal	Average size of properties per block: federal ownership
15.	Average Value of Property	Average value of properties per block
16.	Value: Private	Average value of properties per block: private ownership
17.	Value: Commercial	Average value of properties per block: commercial ownership
18.	Value: Institut-ional	Average value of properties per block: institutional ownership
19.	Value: Municipal	Average value of properties per block: municipal ownership
20.	Value: Federal	Average value of properties per block: federal ownership
21.	Block Size	
22.	Lot Coverage: 1971	Built-up area
23.	Total Assessed Value	Total assessed value includes land and building stock
24.	Tot. No. of Buildings: 1961	Total number of buildings: 1961
25.	No. of Storeys Below Ground: 1961	Number of storeys below ground level: 1961 (excludes ground level)
26.	No. of Storeys Above Ground: 1961	Number of storeys above ground level: 1961 (excludes ground level)
27.	Tot. Floor Space: 1961	
28.	Lot Coverage: 1961	Built-up area

TABLE 25--Continued

29.	Tot. No. of Buildings: 1971	Total number of buildings: 1971
30.	No. of Storeys Below Ground: 1971	No. of storeys below ground level: 1971 (excludes ground level)
31.	No. of Storeys Below Ground: 1971	Number of storeys below ground level: 1971 (excludes ground level)
32.	Tot. Floor Space: 1971	
33.	Residential: 1961	Residential floor space
34.	Residential Commercial: 1961	Floor space devoted to hotels and other transient lodging
35.	Government: 1961	Floor space devoted to government activities; includes federal, municipal and provincial activities, the latter two accounting for about 1% of the total central area government floor space
36.	Finance: 1961	Floor space devoted to banks and other financial institutions
37.	Diplomatic: 1961	Floor space devoted to diplomatic activities
38.	Other office: 1961	Floor space devoted to other types of office activities including all professional services
39.	Ret. Serv. and Repair: 1961	Floor space devoted to retail, services and repair
40.	Auto. Sales and Serv : 1961	Floor space devoted to automotive sales and services including car rental agencies

TABLE 25--Continued

41.	Rest. and Entert.: 1961	Floor space devoted to restaurants and other types of entertainment activities
42.	Whole. and Warehousing: 1961	Floor space devoted to wholesale and warehousing; includes warehousing facilities for retail stores in 1961
43.	Manufacturing: 1961	Floor space devoted to manufacturing activities including printing and newspaper publishing
44.	Util. and Pub. Serv.: 1961	Floor space devoted to utilities and public services
45.	Other Unclass.: 1961	Floor space devoted to other unclassified activities including vacant floor space
46.	Open Parking: 1961	
47.	Enclosed Parking: 1961	
48.	Population: 1961	Resident population from census data
49.	Institutional: 1961	Floor space devoted to institutional activities such as rectories, churches and schools
50.	Residential: 1971	Residential floor space
51.	Residential Commercial: 1971	Floor space devoted to hotels and other transient lodging
52.	Government: 1971	Floor space devoted to government activities; includes federal, municipal and provincial activities the latter two accounting for about 1% of the total central area government floor space

TABLE 25--Continued

53.	Finance: 1971	Floor space devoted to banks and other financial institutions
54.	Diplomatic: 1971	Floor space devoted to diplomatic activities
55.	Other Office: 1971	Floor space devoted to other types of office activities including all professional services
56.	Ret. Serv. and Repair: 1971	Floor space devoted to retail, services and repair
57.	Auto. Sales and Serv.: 1971	Floor space devoted to automotive sales and services including car rental agencies
58.	Rest. and Entert.: 1971	Floor space devoted to restaurants and other types of entertainment activities
59.	Whole and Warehousing: 1971	Floor space devoted to wholesale and warehousing; does not include warehousing facilities for retail stores in 1961
60.	Manufacturing: 1971	Floor space devoted to manufacturing activities including printing and newspaper publishing
61.	Util. and Pub. Serv.: 1971	Floor space devoted to utilities and public services
62.	Other Unclass: 1971	Floor space devoted to other unclassified activities including vacant floor space
63.	Open Parking: 1971	
64.	Enclosed Parking: 1971	

TABLE 25--Continued

65.	Population: 1971	Residential population from census data
66.	Institutional: 1971	Floor space devoted to institutional activities such as rectories, churches and schools
67.	Stores: Food	Number of food stores
68.	Stores: Gen. Merch.	Number of general merchandise stores
69.	Stores: Auto.	Number of automotive sales and accessories stores
70.	Stores: Apparel	Number of apparel stores
71.	Stores: Hardw.	Number of hardware, furniture and home furnishings stores
72.	Stores: Other Ret.	Number of other retail stores
73.	Front: Food	Total food store frontage
74.	Front: Gen. Merch.	Total general merchandise store frontage
75.	Front: Auto.	Total automotive sales and accessories store frontage
76.	Front: Apparel	Total apparel store frontage
77.	Front: Hardw.	Total hardware furniture, home furnishings store frontage
78.	Front: Other Ret.	Total other retail frontage
79.	Area: Food	Total food store sales area (excludes storage space)
80.	Area: Gen. Merch.	Total general merchandise sales area (excludes storage space)

TABLE 25--Continued

81.	Area: Auto.	Total automotive sales and accessories sales area (excludes storage space)
82.	Area: Apparel	Total apparel sales area (excludes storage space)
83.	Area: Hardw.	Total hardware, furniture, home furnishings sales area (excludes storage space)
84.	Area: Other Ret.	Total other retail sales area (excludes storage space)
85.	Tot. Ret. Outlets	Total number of retail outlets
86.	Tot. Ret. Frontage	Total retail frontage
87.	Employees	Total number of employees
88.	Value Constr. - 100	Total value of construction as measured by construction permits issued for a value less than 100,000 dollars between 1969 - 1972
89.	Value Constr. + 100	Total value of construction as measured by construction permits issued for a value greater than 100,000 dollars between 1969 - 1972
90.	Other Office	Floor space devoted to office activities other than government; includes professional, diplomatic and financial services. (This variable groups variables 53, 54 and 55)
91	Parks	Officially designated parks as well as green spaces park-like in character
92.	Vacant Open Space	Excluding parks and similar green spaces

APPENDIX B

RETAIL ACTIVITY 1971: CORRELATION MATRIX

TABLE 26

RETAIL ACTIVITY 1971: CORRELATION MATRIX*

		67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
67.	Stores:Food	1.00																	
68.	Stores:Gen. Merch.		1.00																
69.	Stores:Auto.			1.00															
70.	Stores:Apparel		.39		1.00														
71.	Stores:Hardware	.35			.45	1.00													
72.	Stores:Other Ret.				.65	.46	1.00												
73.	Front:Food	.88						1.00											
74.	Front:Gen. Merch.		.88		.33				1.00										
75.	Front:Auto.			.77						1.00									
76.	Front:Apparel		.48		.86	.36	.45	.31	.39		1.00								
77.	Front:Hardware				.32	.76					.34	1.00							
78.	Front:Other Ret.				.43		.67				.42		1.00						
79.	Area:Food	.77				.32		.89				.34		1.00					
80.	Area:Gen. Merch.		.70						.91		.31				1.00				
81.	Area:Auto.			.38						.83						1.00			
82.	Area:Apparel		.53		.88	.32	.47		.45		.93		.38		.37		1.00		
83.	Area:Hardware					.49						.80						1.00	
84.	Area:Other Ret.				.46		.67				.32		.85				.36		1.00

* Correlation Matrix for 82 units of observation

APPENDIX C

COMPREHENSIVE CENTRAL AREA ANALYSIS:

ROTATED FACTOR SCORES

TABLE 27

COMPREHENSIVE CENTRAL AREA ANALYSIS: ROTATED FACTOR SCORES

Factor 1 Functional Intensity		Factor 2 Federal Ownership		Factor 3 Block Fragmentation		Factor 4 High Value Commercial Ownership		Factor 5 Retail vs. Residential		Factor 6 High Value Private Ownership		Factor 7 Open vs. Enclosed Parking	
Block	Score	Block	Score	Block	Score	Block	Score	Block	Score	Block	Score	Block	Score
53	3.5	. . . . .		12	3.0	. . . . .		35	2.6	61	4.6	79	4.1
61	3.0	63	-0.2	3	2.8	76	-0.1	45	2.4	62	3.8	82	2.9
43	2.8	79	-0.8	2	2.3	62	-0.2	47	2.0	80	3.2	81	2.1
65	2.3	82	-1.5	8	2.2	27	-0.2	25	1.9	36	1.5	22	1.9
64	2.1	81	-1.8	5	1.7	15	-0.2	20	1.7	78	1.0	23	1.7
59	1.9	22	-1.9	21	1.4	63	-0.2	26	1.6	74	0.8	30	1.0
79	1.6	48	-2.5	9	1.3	70	-0.3	13	1.5	46	0.7	64	0.7
23	1.2	32	-7.5	73	1.2	64	-0.3	15	1.4	26	0.5	75	0.6
81	1.0			4	1.1	43	-2.5	46	1.3	35	0.5	15	0.6
82	0.8			55	1.0	53	-3.2	36	1.3	71	0.4	74	0.6
75	0.8			15	0.9	22	-7.3	66	1.0	. . . . .		65	0.5
35	0.8			71	0.9			8	1.0			16	0.4
66	0.8			70	0.9			44	0.9			. . . . .	
52	0.7			69	0.9			60	0.7				
74	0.6			66	0.9			19	0.7				
60	0.5			6	0.8			18	0.7				
48	0.5			16	0.7			76	0.6				
36	0.4			10	0.7			11	0.6				
. . . . .				72	0.6			67	0.6				
				56	0.6			10	0.6				
				77	0.5			61	0.4				
				57	0.4			. . . . .					
				. . . . .									

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