To the Graduate Council:

I am submitting herewith a thesis written by Gregory Lee Errett entitled "Knoxville's Street and Highway System: An Examination of Its Evolution." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science in Planning.

George E. Bowen, Major Professor

We have read this thesis
and recommend its acceptance:

Accepted for the Council:

The Graduate School

KNOXVILLE'S STREET AND HIGHWAY SYSTEM:
AN EXAMINATION OF ITS EVOLUTION

A Thesis

Presented for the

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Degree

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Gregory Lee Errett

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ABSTRACT

Since the beginning of time, mankind has developed systems of streets and highways. Many factors have influenced the design and layout of these facilities. Often these street and highway systems were poorly planned, and as a result, many problems developed. With the growing popularity of the automobile, cities are faced with the challenge of mitigating the variety of street design problems which exist while providing adequately designed street and highway facilities for future generations.

A wide cross-section of cities were examined for details regarding their development. Starting with the early cities of Mohenjo-Daro and Harappa, this thesis reviewed the design and layout of street and highway facilities around the world and the United States. This information was used as a base to understand the design and layout of Knoxville's street and highway system.

The historical evolution of Knoxville's street and highway system covers two full centuries. During this period of time, Knoxville witnessed the convergence of poorly designed street systems of surrounding suburbs and cities into a configuration of confusing street patterns and dangerous intersections. The lax of good planning plus the inability to make appropriate changes in the design and layout of the street and highway system over time have been primarily causes of Knoxville's street design problems.

TABLE OF CONTENTS

CHAPTER		PAGE
I.	INTRODUCTION	1
	A. Problem Statement	2
	B. Need for this Study	6
	C. Research Objectives and Questions	7
	D. Methodology	8
	Written History	8
	Cartographical History	9
	Case Study Investigation	9
	Information Gathering	10
	Examining Specific Street Design Problems	10
	Conducting Interviews	11
	E. Organization of Thesis	11
II.	THE HISTORY OF THE STREET	13
	A. Street and Highway Development Around the World	14
	From the Beginning	14
	Europe and China	21
	Central and South America	31
	The Renaissance in Europe	33
	The Industrial Revolution and the New Town Movement	46
	Dealing with the Automobile	52
	B. Street and Highway Development in the United States	56
	The Laws of the Indies	58
	The Gridiron in American Colonization	61
	Non-Gridiron Cities in American Colonization	73
	Northwest Land Ordinance of 1785	90
	City Street Design in the Midwest	94
	City Street Design in the West	113
	Road and Highway Planning in America	126
	The Federal Road Act of 1916	131
	The Federal Highway Act of 1921	133
	The Federal-Aid Highway Act of 1944	135
	The Federal-Aid Highway Act of 1956	136
	Transportation Development and City Street Design	139
	Freeways	144
	Arterials	145
	Collector Streets	146
	Local Streets	147
	C. Street and Highway Design in Tennessee	149

CHAPTER PAGE

III. THE HISTORY OF KNOXVILLE'S STREET AND HIGHWAY SYSTEM 157

A. The Founding of Knoxville, 1791-1860 160
B. After the Civil War, 1860-1890 176
C. Around the Turn-of-the-Century, 1890-1915 181
D. After World War I, 1915-1940 189
E. After World War II, 1940-1960 230
F. The Westward Movement, 1960-Today 260

IV. CASE STUDY INVESTIGATION 290

A. Historical Review 292
B. Examination of Specific Street Design Problems 297
C. Conducting Interviews 306

V. SUMMARY AND CONCLUSIONS 309

A. Summary 310
B. Conclusions 315

BIBLIOGRAPHY 323

APPENDIX 349

VITA 351

LIST OF FIGURES

FIGURE		PAGE
1.	Plans of Mohenjo-Daro and Harappa	19
2.	Plans of Priene and Miletus	23
3.	Plan of Timgad	26
4.	Medieval Mantua	29
5.	Renaissance Nancy	36
6.	Renaissance Palma Nova	40
7.	Renaissance Paris	42
8.	Ebenezer Howard's Garden City	49
9.	Letchworth Garden City	50
10.	Welwyn Garden City	51
11.	Marlborough, Virginia	63
12.	Philadelphia, Pennsylvania	66
13.	Philadelphia Hinterlands	69
14.	Savannah, Georgia	71
15.	The Growth of Savannah: 1733-1856	72
16.	New York City, New York	75
17.	New York City in 1797	77
18.	Boston, Massachusetts	81
19.	Annapolis, Maryland	83
20.	Salem, Massachusetts	84
21.	Washington, D.C.	87
22.	Northwest Land Ordinance of 1785 Meridians and Base Lines	92
23.	Franklinville and Lystra, Kentucky	95
24.	Hygeia, Kentucky	97
25.	Jeffersonville, Indiana	98
26.	Indianapolis, Indiana	101
27.	Circleville, Ohio	103
28.	Esperanza, New York	104
29.	Buffalo, New York	106
30.	Cleveland, Ohio, in 1796	107
31.	Cleveland, Ohio, in 1835	108
32.	Sandusky, Ohio	110
33.	Detroit, Michigan	112
34.	New Orleans, Louisiana	115
35.	Santa Fe, New Mexico	117
36.	Los Angeles, California	119
37.	San Francisco, California	121
38.	Helena, Montana	124
39.	Tacoma, Washington	125
40.	Redondo Beach, California	127
41.	Radburn, New Jersey	150
42.	Tennessee Highways in 1817	153
43.	Tennessee Highways in 1919	155

FIGURE PAGE

44. Knoxville in 1791 162
45. Knoxville in 1795 164
46. Knoxville in 1855 171
47. Knoxville in 1863 177
48. Knoxville in 1895 184
49. Growth of Knoxville Before 1900 185
50. Annexations and Undeveloped Areas 190
51. Present Street Widths 200
52. Paved Streets, Jogs and Dead Ends 203
53. Existing Street Grades 206
54. Major Street Plan 209
55. Major Street System Diagrams 210
56. Details of Street Improvements 214
57. Principles of Land Subdivision 219
58. Cross-Sections of Streets 221
59. Riverfront Plan 232
60. Knoxville in 1945 234
61. Intersection of Broadway, Western Avenue and Henley Street 240
62. Clinch Avenue/Church Avenue Connection 241
63. Knoxville in 1948 244
64. Magnolia Extension Expressway 248
65. Magnolia Extension Clearance Plan 249
66. Downtown Loop 256
67. Model Residential Area 263
68. Collector Street Guidelines 287
69. Case Study Investigation Boundary 291
70. Growth of the Street System 293
71. Hierarchy of Streets 299
72. Street Jogs, Dead-End Streets and Street Closures 301
73. Acute-Angled and Multi-Leg Intersections 305
74. Street Grades in Excess of Maximum Standards 307

CHAPTER I

INTRODUCTION

> The history of transportation in cities is important for today's designer to recognize as it provides insight into the reason for many of the constraints and problems which significantly affect street design efforts.[1]

In the historical evolution of cities in the world, travel has prevailed as a constant condition of urban life. The movement of man and the products of his civilization generally were accomplished by foot, horse, cart, wagon and motorized vehicles. These modes of transportation required the establishment and development of "movement corridors," or streets.

With the growth of a city, streets began to develop patterns. "These patterns were usually influenced by a process of accretion--the growth was irregular in form, sensitive to changes in the habits of people, and dynamic in character."[2] Street patterns often developed in an unconstrained and unplanned context. While exceptions can be found in Washington, D.C., Savannah, Georgia, and other planned towns, these efforts were unusual.

"The orderly and logical layout of a city's streets was not

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[1] JHK and Associates, Design of Urban Streets (Washington, D.C.: United States Government Printing Office, 1980), p. 2-1.

[2] Arthur B. Gallion and Simon Eisner, The Urban Pattern, City Planning and Design (New York, New York: D. Van Nostrand, 1975), pp. 2-3.

considered necessary due to low traffic speed and low traffic volume."[3] By the early 1920's, however, the automobile was making progress toward becoming the predominant form of personal transport, both in urban and rural areas. "Street design changes soon became necessary to convert street systems from low-speed pedestrian and horse travel and from use of streetcars to systems which could handle automobiles in large numbers and at higher speeds."[4]

In the 1950's and 1960's urban development created the need for major additions and improvements to the urban street and highway system. The emphasis was on freeway and expressway construction, however, improvement of the local arterial and collector street system was kept at a minimum. Recently there has been a shift from major new construction as the pace of urban growth has slowed considerably. Due to financial and environmental constraints the new emphasis is on upgrading and revitalizing existing surface street systems in cities.[5]

A. PROBLEM STATEMENT

> The haphazard and unsystematic street layout is the result of past lack of interest in the city's problems of growth. Land subdividers laid out their streets according to their own ideas and did not realize that they were building the framework for a city. These men were not entirely to blame for their actions, as the city had no plan to guide them.[6]

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[3] JHK and Associates, loc. cit.

[4] Ibid.

[5] Ibid., pp. 2-1 to 2-2.

[6] Harland Bartholomew and Associates, A Report on a System of Major Streets for Knoxville, Tennessee (Knoxville, Tennessee: City Planning Commission, 1927), p. 25.

A person might interpret the statement above as a comment originating from the Knoxville-Knox County Metropolitan Planning Commission's General Plan 2000, however, Harland Bartholomew and Associates working with the City Planning Commission of Knoxville made this revealing observation in 1927. Knowledge of the maladies of poor street design and layout have been in existence for more than 50 years, but it has only been in recent years that significant efforts have been attempted to mitigate these problems.

Knoxville's troubles with the design and application of its street and highway system began in 1791 when the town was founded. Captain James White laid out the original town plan on the steep banks of the Tennessee River in order to provide protection from the Cherokee Indians. The plan called for development to be organized into sixteen blocks in which the streets would be in a grid configuration. The platted streets began at the river and were designed to traverse the steep cliffs where the City/County building stands today. Access to commerce on the river plus the geographical advantages of defense were the primary reasons that Knoxville's street system was laid in difficult terrain. While the streets were sufficiently wide enough for the movement of men and wagons, the topography made these movements extremely difficult. These unfortunate beginnings set a pace for the growth of Knoxville's street and highway system over the next 190 years.

The city slowly grew and in its growth acquired additional territory. In 1855 the limits extended as far north as Fifth Avenue, east to the intersection of East Main and Vine Street, west to Second

Creek and south to the river. Very little additional territory was taken in by the city for a number of years and in the meantime the population was growing in suburban territory outside the city limits. Satellite towns were established in the vicinity of Knoxville as separate corporations, among them being Park City, East Knoxville, West Knoxville, North Knoxville and Mechanicsville. Each of these new suburban towns platted and developed their own street systems, totally unaware of its future effects on circulation for the region.

By the 1920's, Knoxville's character was changing due to the popularity of the automobile. The city was becoming motorized as one out of six people owned an automobile. The impacts of this technological change were becoming obvious to everyone. Traffic jams, accidents and poor traffic circulation were caused, in part, because the number of vehicles traversing Knoxville's street system were greater than the system could carry. Knoxville's street system also did not function properly because of the proliferation of poorly designed streets and intersections, the lack of a definitive hierarchy of streets, and the absence of a plan to guide the development and coordination of a city-wide street system. Harland Bartholomew and Associates along with the City Planning Commission of Knoxville attempted to address these problems in 1927 when a specific set of recommendations for a comprehensive street network plan were developed.

Concurrent with the nation's needs for interstate and intrastate highway facilities, the United States Federal Highway Administration (FHWA) and the Tennessee Department of Transportation (TDOT) have developed and are continuing to develop a high-speed highway network in

Knoxville and the Knoxville region. The development of these facilities have come through two distinctively different methods: 1) the designation and upgrading of existing major streets and roads into U.S. and Tennessee state highways, and 2) the design and construction of brand new facilities (primarily the Interstate system of I-40, I-75, I-275, and I-640) amidst an existing surface street system in Knoxville. Both of these procedures have created significant impacts on the total street and highway system in Knoxville. Neighborhoods have been broken up into areas which must depend on one or two "through" streets for access, many dead-end streets were created, and congestion and circulation problems around interchanges and/or major signal controls were the most obvious impacts that resulted from the development of highway facilities. It is generally believed that the design and placement of these facilities often followed the whims of local political and economic interests and were not always based on sound planning and engineering judgment.

In recent years, Knoxville has made significant strides in mitigating these problems. Hundreds of millions of dollars have been and will continue to be spent to correct deficient highway facilities, poorly aligned intersections and street jogs, congested and dangerous collector and arterial streets, etc. The most widely recognized project in Knoxville and possibly the United States, "Malfunction Junction," was recently upgraded to meet federal highway design standards. However, these efforts are only the tip of the iceberg as many areas of the town continue to suffer from the variety of street and highway design problems mentioned above.

B. NEED FOR THIS STUDY

In an attempt to avoid repeating the mistakes or actions of the past, the history of a particular topic is often examined. The subject of urban planning is no exception. The physical composition of a city is the result of a continuous series of events which have shaped and influenced its form and character. The problems of a city are often a reflection on its leaders' inability to understand a region's history.

Knoxville has a long and varied history. A significant portion of its history has involved the development of transportation technologies and facilities. The state-of-the-art knowledge of street and highway design has evolved gradually over the last two centuries, primarily as a result of the technological changes made in transportation during this period of time. Each step of this process has caused a variety of problems and has produced new requirements for street and highway design. In examining the history of Knoxville's street and highway system, the problems of its evolution have become clear.

The purpose of this study was to assemble a comprehensive history of Knoxville's street and highway system in order to provide a basis for individuals to understand the direction the system may take. While it is not certain what form of transportation may dominate in the future, a lot of energy, time and money have been spent and are going to be spent on the correction and development of facilities for the movement of automobiles. It is imperative that these expenditures be made wisely. Understanding the history of the development of these facilities in Knoxville may assist in this process.

C. RESEARCH OBJECTIVES AND QUESTIONS

The objectives of this study were to obtain an overall understanding of the forces which have influenced and will continue to influence the design and development of streets and highways in cities, specifically Knoxville; and, to foster a further understanding of the relationships between land use, transportation/circulation, and the natural and man-made characteristics of cities, again specifically Knoxville.

The specific research questions associated with these objectives were:

1. What were the policies and/or decisions that influenced the physical layout of Knoxville's street and highway system?
2. What other factors have influenced the design and layout of Knoxville's street and highway system?
3. What physical impacts to land use and transportation/circulation have been created due to past decisions on street and highway design and placement in Knoxville?
4. How did the design and construction of Interstate highways influence and affect street patterns and circulation in Knoxville, specifically within the case study investigation area?
5. Based on the premise that knowledge in the field of street and highway design has advanced significantly in the last two centuries, have these principles been applied effectively in Knoxville?

D. METHODOLOGY

The first step in this research effort was the identification and examination of pertinent literature on the history of streets and highways. Specific areas of study included the history of all modes of surface transportation and their influence on street and highway design, the evolution of physical street and highway design and their application in cities and rural areas, and the continuous involvement of different levels of government for the provision of street and highway facilities. This general overview of the topic was necessary before narrowing down to an examination of Knoxville's situation. This portion of the thesis was developed from a literature review of books, periodicals, reports and studies. These documents were produced by many sources, including federal and state government, historians, universities, research organizations, engineers and planners.

The second portion of this study was a review of all materials relating to the historical evolution of Knoxville's street and highway system. All available information was gathered and analyzed in a chronological sequence. The historical review process was divided into two main areas, the written history and the cartographical history of Knoxville. Also, a case study was developed to look at a portion of Knoxville's street and highway system in more detail. Each of these areas are described below.

Written History

Knoxville's street and highway system was analyzed through an examination of available written materials. Books describing the

history of Knoxville/Knox County/East Tennessee; public documents registering the policies/decisions, plans and implementation strategies regarding the development of Knoxville's street and highway system; newspaper accounts of events and information; and, published and unpublished reports from various agencies and individuals were the primary sources of information which were used in this thesis.

Cartographical History

Knoxville's street and highway system was also examined cartographically. This analysis was achieved by reviewing historical maps and illustrations in books, public documents, newspapers, and reports; and, examining separate maps and aerial photographs. The primary sources of this information included the Knoxville-Knox County Metropolitan Planning Commission, The Calvin M. McClung Historical Collection at the Knoxville-Knox County Public Library, and the Estes Kefauver Historical Collection at The University of Tennessee Main Library. These maps were used to graphically understand and depict the historical evolution of Knoxville's street and highway system.

Case Study Investigation

The third step in this study was a case study investigation of a portion of Knoxville's street and highway system. The area chosen for study consisted of portions of Fort Sanders, Mechanicsville, North Central Knoxville, the Fourth and Gill neighborhood, and the Central Business District (see Figure 69 on page 291 in Chapter IV). This area was chosen because it represented a cross-section of the total history of Knoxville's street and highway system. The total study area

features a wide variety of streets and street patterns, street design problems, highway facilities, land uses, and neighborhoods. The case study investigation was divided into three different activities. They were:

Information gathering. The case study area was specifically examined through the written and cartographical analyses described above. The information gathered provided a basis for examining specific street design problems within the case study boundary.

Examining specific street design problems. After the written and cartographical history analyses of the case study investigation area were completed, specific design problems and applications to the physical street and highway layout within the case study investigation area were identified and examined. Examples of the problems that were studied included:

1. The effect of the Interstate highway system on local and regional street patterns and systems.
2. Multi-leg intersections.
3. Dangerous, acute-angled intersections.
4. Street jogs.
5. The lack of a distinctive hierarchy of streets and arterials.
6. Dead-end streets and street closures.
7. The effect of past and present procedures and applications to reduce area traffic and circulation problems.

8. Operational changes (i.e., implementing one-way streets or pairs, establishing traffic control devices like curbs, medians, signage, signals, etc.).
9. Topography and other natural physical constraints.
10. Railroads and other man-made physical constraints.

Typical information that was gathered and studied included the history of proposed ideas and concepts to reduce or eliminate street and highway design problems within the case study investigation boundary, and the physical characteristics of street and highway system in the area.

Conducting interviews. To further identify and understand the quantity and quality of problems that exist within the case study investigation area, a series of personal interviews were conducted. The interviews were divided into two main areas: 1) interviews with community and neighborhood leaders as well as city officials, traffic engineers and transportation planners who have guided or shaped street and highway design and layout in the case study investigation area and the city, and 2) interviews with lay citizens who live, work, or own property adjacent to examples of the street design problems previously mentioned.

E. ORGANIZATION OF THESIS

The thesis was organized into five chapters. Chapter II provides a detailed examination of the history of the street, particularly as related to the design and layout of the total urban street

network in cities. This enables a better understanding of the significance of the research presented in later chapters.

Chapter III discusses the history of Knoxville's street and highway system. This chapter divides the total history into six logical pieces. Each historical division reflects major changes in the street and highway system due to the advancement of transportation technology, the significant involvement of the federal and Tennessee state governments in the development of the street and highway network, and the constantly evolving needs and values of a nation and community.

Chapter IV is a case study investigation of the area as previously described in the methodology. This chapter is primarily based on research contained in Chapter III but also represents key information from Chapter II. This case study investigation demonstrated the variety of problems that are inherent with street and highway design as a city grows and changes character. Chapter V contains a summary and the major conclusions of the research effort. Each chapter is not considered a separate study. Rather, they are linked together so that understanding Chapter II through V is based on information presented in the preceding chapter.

CHAPTER II

THE HISTORY OF THE STREET

> With the ebb and flow of civilization the irregular and geometrical patterns have been grafted one upon the other. Villages which grew into cities because of geographic, economic, or social advantages may show evidence of geometrical forms superimposed upon an irregular pattern, or an informal system may have been grafted upon a city having an original pattern of gridiron streets. Cities have been subjected to the process of continuous remodeling through the ages, and the variety of forms is the result of forces which dominated during the successive periods of their history. We find the motives of city builders, from emperors to subdividers, reflected in the designs they have stamped upon the city.[7]

Knoxville's street and highway system is an agglomeration of the historical development of the street. In this chapter, the major factors in the evolution of the design of streets in cities and rural areas will be presented. The history of street design was divided into three geographical regions: 1) the history of street design for cities and countries around the world, 2) the history of street and highway design for cities and states in the United States, and 3) the history of street and highway design in Tennessee. Within each of these geographical subdivisions there will be an examination of the development of surface street transportation, and the relationship between these transportation modes and street design. Beginning with the history of street design for cities and countries around the world and ending with the development of a network of streets and highways in Tennessee, it

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[7]Arthur B. Gallion and Simon Eisner, op. cit., p. 3.

is the intention of this chapter to provide an historical perspective in order to understand the evolution of Knoxville's street and highway system.

A. STREET AND HIGHWAY DEVELOPMENT AROUND THE WORLD

From the Beginning

Thousands of years before the invention of the automobile, man traveled to his destinations by foot. His travels often followed the paths formed by the daily passage of wild animals to a watering hole, or from a cave to a spot where game could be caught, or fruit picked. These primitive footpaths were the "forefathers" of the modern street and highway networks developed in cities and countries around the world.

The design and creation of early roads was based on common sense: choose the path of least resistance, not the steepest hills or the swampy areas. Roads often followed the contours of the landscape or the meandering paths of rivers, streams and creeks. Examples of these concepts are still evident in hilly ranching or farming areas where cattle, horses or other animals create paths in the landscape through grazing.

> Somewhere around 8,000 to 10,000 years ago mankind started to exercise some measure of control over the supply of food by systematic cultivation of certain forms of plants, notably the edible wild grass seed, ancestors of barley and wheat, and by the domestication of animals.[8]

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[8] A.E.J. Morris, History of Urban Form, Prehistory to the Renaissance (London, England: George Godwin, Ltd., 1972), p. 3.

Urban historians believe that these initial attempts at controlled food production led to the civilization of man. Families collected into friendly groups and formed villages in which the agrarian population enjoyed the advantages of mutual protection, and trade. Interaction between these villages assisted in the development of a permanent road network. The utility of these early roads, in turn, helped man in the development of better agricultural methods, trade and domestic items such as pottery, tools, jewelry, and cloth weaving. The road became a line of communication in which ideas and information were exchanged.

Parallel to the modern day traffic engineer, man realized that along some of the roads between villages, improvements in the design and construction of these facilities were needed.

> . . . perhaps they threw some rocks in a hole in the trail so they wouldn't stumble. Or they may have cut down some bushes and thrown them into a swampy spot so they could go across it instead of having to go around. Perhaps the trail worn on the side of a hill was narrow and, with their crude tools, they dug away some of the hillside to widen the path.[9]

Modification to the roads between villages reflected man's ability to harness the use of large animals for the transportation of large quantities of agricultural products, building materials and other items of trade. It should be noted that relatively large areas of the world are still in the pack-trail stage of transportation development, and these areas continue to create roads in primitive fashion.

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[9]Fon W. Boardman, Jr., Roads (New York, New York: Henry Z. Walck, Inc., 1958), pp. 11-12.

"The desire to transport much heavier loads than could be carried by pack animal led to the use of the roller, and also the sled."[10] For example, wooden rollers were used effectively on roads in moving massive blocks of stone utilized in building the great pyramids of Egypt. Once again, modifications to the design and construction of these roads required that they be widened and straightened to accommodate the increased volumes of traffic and the larger quantities of materials to be transported.

For thousands of years the development of road design lay dormant. The number of villages continued to grow along with the network of interconnecting roads and paths, however, the technical design and sophistication of these roads remained unchanged.

By the year 4000 B.C., Neolithic folk society villages began a transformation into the first cities. This "urban revolution" was initiated in the north-west delta area of Egypt where the city of Merimde was founded.[11] It can be claimed that the first city street was developed here as "the settlement occupied an area of at least 600 by 400 yards in which the huts were arranged in two definite rows with a street between."[12]

As man entered the Bronze Age, between 3500 and 3000 B.C., the urban revolution began to take hold. City life grew, writing

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[10]Arthur G. Bruce, Highway Design and Construction (Scranton, Pennsylvania: International Textbook Company, 1934), p. 2.

[11]A.E.J. Morris, op. cit., p. 5.

[12]Ibid.

developed, and trade became an important and organized part of life. The importance of having a good road system was realized.

Trading of goods and materials took on an international flavor as many roads were built with direct connection to river and ocean ports, particularly around the "fertile crescent" area of the Near and Middle East. Many families became dependent on trade, and thus on roads, to make a living. As people migrated toward the cities and were no longer self-supporting on small farms, these city dwelling men and women depended on roads to bring them food and other goods to survive. Mankind was finally able to communicate with other parts of the world through these new roads.

During the Bronze Age, the development of a good road system was necessary for protection purposes. Governments of the time grew stronger and controlled larger areas outside the cities. To do this, roads in which armies could march and orders could be sent, were built. Conversely, "small local rulers felt that they were better protected from their enemies by not having road communication, therefore, road building was discouraged."[13]

Probably the single most important event associated with the history of the street is the invention of the wheel.

> The wheel was developed during the Bronze Age, as a by-product of battle, first used on chariots of war. It was soon adopted for peaceful pursuits in the form of the two-wheeled cart. Later, a front pair of wheels was added, and thus the wagon came into use.[14]

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[13]Arthur G. Bruce, op. cit., p. 3.

[14]Ibid., p. 2.

The invention of the wheel and its use on chariots, carts and wagons changed land travel completely. Now better roads were needed and were worth building. A draft animal pulling a cart over a smooth road could now carry much more weight and do it faster, too. City streets were often paved with stone or brick to support the weight of these new vehicles.

With the development of the first cities, the design of city streets and roads to accommodate larger populations, new wheeled vehicles, and trade movements, became increasingly important. Initially, most cities grew in an "organic," unplanned way, with streets being formed through the natural settlement of its residents. "Later, planned urban form, with predetermined street patterns generally based on a simple rectilinear gridiron, appeared after the first settlements acquired urban status through organic growth processes."[15] Examples of planned urban form can be found in the ancient Indian cities of Mohenjo-Daro and Harappa, where the streets were arranged in a regular grid pattern with the dwellings compactly built around interior courts and alleys (see Figure 1).[16] Also, in these two cities, "the heights of buildings were established in proportion to the width of streets."[17] Clearly, the designers of Mohenjo-Daro and Harappa recognized the need for a hierarchy of streets in a city, and

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[15]A.E.J. Morris, op. cit., p. 9.

[16]Arthur B. Gallion and Simon Eisner, op. cit., p. 4.

[17]Ibid.

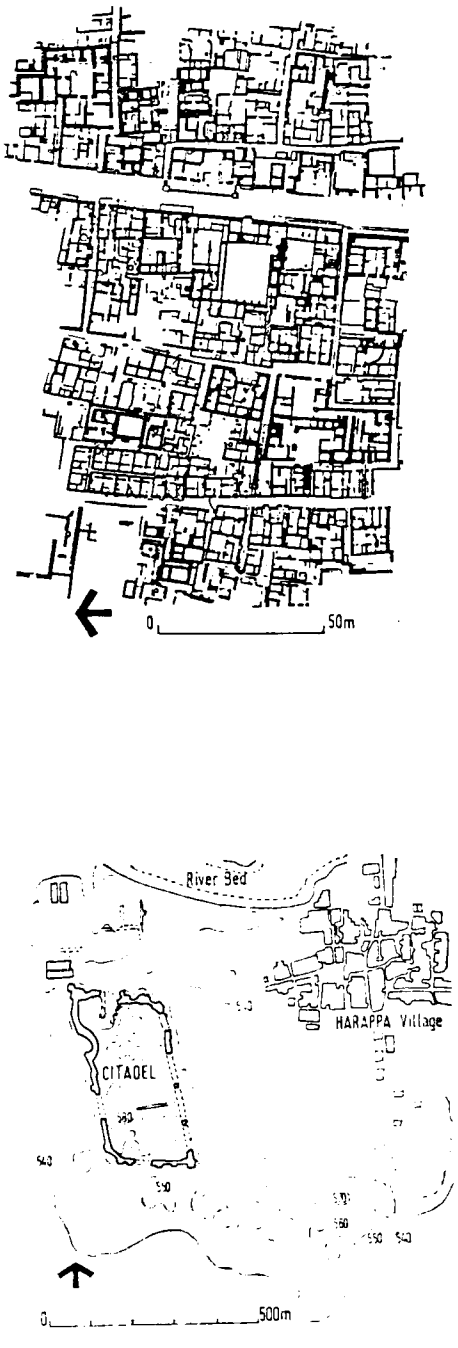


Figure 1. Plans of Mohenjo-Daro and Harappa.

Source: A.E.J. Morris, History of Urban Form, Prehistory to the Renaissance (London, England: George Godwin, Ltd., 1972), p. 17.

the relationship between building square footage/land use and the volumes of traffic that could be generated.

In many ancient cities, the width of the streets were based on the social status of the people living along those streets. For example, laborers often lived in small dwellings along narrow streets while emperors and kings lived in large palaces along wide streets and boulevards. Although street patterns were often in gridiron configurations, the varying width of these streets typically made these streets appear less than organized to the traveler.

Many early cities were designed to have at least one street serve as the main street in town. These main streets were often very wide and were laid out for sacred processions, for marching soldiers, and for conducting trade.

> The frequent orientation of the main avenues to the points of the compass indicated the growing dominance of the sky gods; this layout sometimes flouted more practical considerations, such as tempering the heat or catching the prevailing winds.[18]

To further amplify the importance of the wide, main street in these cities, it should be remembered that these cities were military-oriented. To demonstrate the armies' strength, the local rulers

> . . . required that these streets should be straight. Anyone who has ever led a company of men through an irregularly planned city knows the difficulty of conducting them in martial order through its windings and twistings, particularly when the streets themselves are ungraded: inevitably, the individual falls out of

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[18]Lewis Mumford, The City in History, Its Origins, Its Transformations, and Its Prospects (New York, New York: Harcourt, Brace and World, Inc., 1961), p. 73.

> alignment and the ranks present a disorderly appearance. To achieve the maximum appearance of order and power on parade, it is necessary to provide a body of soldiers either with an open square or a long unbroken avenue.[19]

As these initial cities developed over the centuries, changes to the existing street patterns became commonplace. These design adjustments reflected both man's and nature's influence on a city. Man's impact on the street patterns was generated from early attempts at redevelopment, where entire sections of town were torn down and redeveloped, or new sections of town were built atop decaying neighborhoods. Most of the early cities developed along the Nile, Tigris-Euphrates, and Indus Rivers where food, water and transportation were at hand. But since the early cities often existed in a flood plain where the soils were fertile and rich, they were subject to periodic or annual flooding. The floods often wiped out portions of a city, requiring the redesign of streets and street patterns.

Europe and China

At approximately 1000 B.C., networks of roads began to spring up with the development of new cities in areas other than the fertile crescent. Road networks were developed in Europe and China, both with direct connections to the Middle East.

> In China, the people created such a good system of roads that it became necessary to develop the first set of road regulations. The regulations prescribed a certain size for wheeled vehicles, set speed limits, and established rules for busy crossings.[20]

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[19] Ibid., pp. 368-369.

[20] Fon W. Boardman, Jr., op. cit., p. 22.

Chinese cities were typically designed as an entity, sensitive to the perceptions created through pedestrian movements. Citizens moved along streets designed in a gridiron configuration that was based on an east-west, north-south system of axes. The gridiron pattern allowed the Chinese to create a uniform modular system of buildings, in which a progression of interesting spaces would be born along the axes. The gridiron blocks, called "bo," were "usually subdivided by smaller crossing roads into four similar oblong blocks, and as a result it was possible to arrange every house facing the sun, and with a courtyard garden."[21]

For the last three thousand years, European cities and countries have made significant contributions to the development of city street design. Refinement of the gridiron concept came in the development of two Greek cities, Miletus and Priene (see Figure 2). These cities were designed by Hippodamus, the famous architect and city planner, who is often mistakenly called the "inventor of the gridiron." Hippodamus designed these two cities with gridiron patterns running north-south, east-west because he believed these patterns would allow for more light to shine on the wide boulevards traversing east-west.

> Superimposing the rigid geometrical form of the Hippodamian street system upon the rugged topography of the sites occupied by most Greek cities created numerous streets so steep they could be negotiated only with steps. Since the movement of people was almost entirely on foot, this did not present the problem we might assume today although there were some puffing Grecians who reached the top of a long climb to attend a political meeting in the

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[21]A.E.J. Morris, op. cit., p. 244.

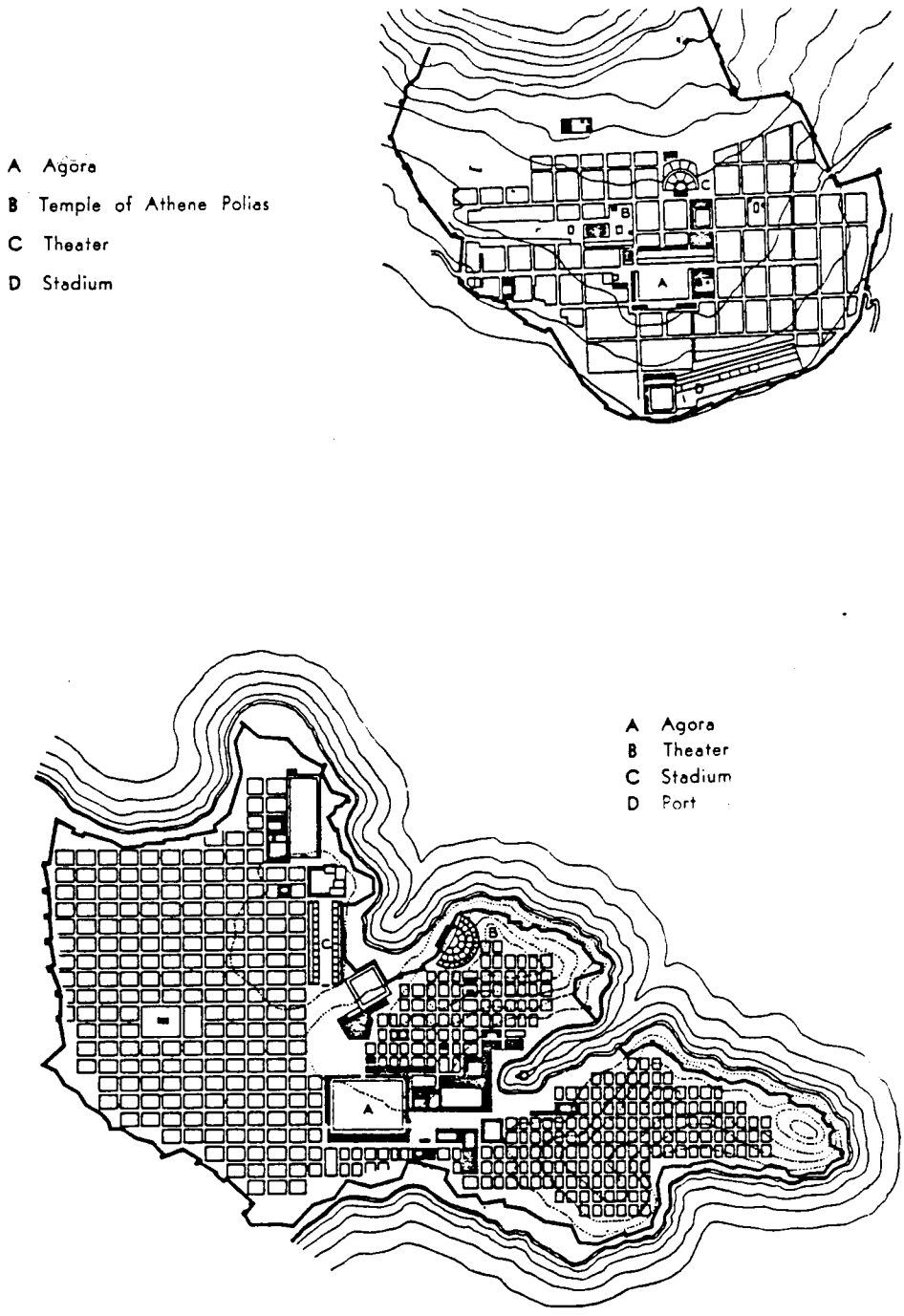


Figure 2. Plans of Priene and Miletus.

Source: Arthur B. Gallion and Simon Eisner, The Urban Pattern, City Planning and Design (New York, New York: D. Van Nostrand Company, 1975), p. 20.

assembly hall. The principal traffic streets, however, were placed to allow the circulation of the horse-drawn vehicles which entered town.[22]

To the Greeks, the national road system was considered sacred. The Greeks, like the Egyptians of centuries before, developed roads which were routes to temples where the sacred fire was guarded. "Roads were considered such integral parts of temples that they shared in the old rights of asylum."[23] Greeks also developed roads which were designed to meander. They did this because they believed it to be of barbaric taste to build straight roads like the Persians or imperial roads like the Romans.[24]

Another major contributor to the development of the design of city streets and roads was the Romans. Their influence can be seen in two principal areas: 1) the development of an incredible road system to march their troops great distances, and 2) the creation of thousands of gridiron military camps.

The development of the Roman road system took more than five hundred years to achieve. The roads were aligned to cover all of Europe, Asia and North Africa. Their primary purpose was to facilitate the movement of great armies to protect and expand the Roman empire. Similar to the wide main avenues of cities in previous centuries, the Romans designed their roads straight in order for the troops to march

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[22]Arthur B. Gallion and Simon Eisner, op. cit., p. 18.

[23]Christy Borth, Mankind on the Move, The Story of Highways (Washington, D.C.: Automotive Safety Foundation, 1969), p. 16.

[24]Ibid.

in unison, providing an image of power and organization. A perfect contemporary example of this concept can still be seen in the Appian Way, a former Roman road now used as a national highway. Considering the scientific knowledge and the instruments they had available, the Romans were masterly in their laying out of routes for roads.

The Romans built thousands of fortified legionary camps known as "castras" in order to be used as temporary centers for local military activities.[25] "Such camps had to be operational in the shortest time and, were laid out according to the gridiron, with predetermined rectilinear defensive perimeters."[26] Many of these temporary establishments formed the basis of permanent towns, all of which retained the gridiron street pattern concept. Accessibility was a main siting requirement and in place of the comparatively isolated but more readily defended hilltop sites preferred by their Celtic predecessors and German successors, the Romans opted for river crossings and route intersections.[27]

Castras generally had two main streets, the "decamanus" and the bisecting "cardo."[28] The Roman forum, a large open space used for public meetings and trade, was often located at the intersection of the decamanus and cardo. Figure 3 is a classic example of the Roman castra. The plan is of Timgad, located in Algeria, North Africa.

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[25] A.E.J. Morris, op. cit., p. 39.

[26] Ibid.

[27] Ibid., p. 40.

[28] Ibid., p. 39.

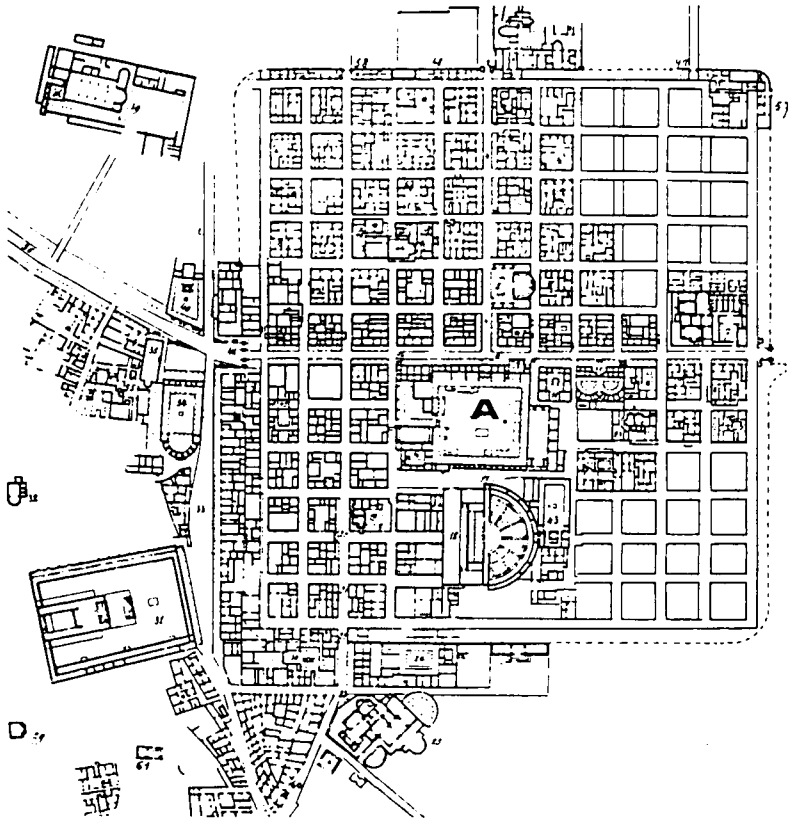


Figure 3. Plan of Timgad.

Source: A.E.J. Morris, History of Urban Form, Prehistory to the Renaissance (London, England: George Godwin, Ltd., 1972), p. 55.

Letter A shows where the forum was built. Outside the original perimeter organic growth with irregular street patterns can be seen.

In the city of Rome, engineers further developed the concepts of street hierarchy and functional classification of streets by requiring different types of streets to be built according to land use and traffic needs.

> The functional zones were linked together by a route system of streets, which always smacked of their ancient origin and maintained the old distinctions which had prevailed at the time of their rustic development: the itinera, which were tracks only for men on foot, the actus, which permitted the passage of only one cart at a time; and finally the viae proper, which permitted two carts to pass each other, or to drive abreast.[29]

Not unlike cities today, Rome experienced traffic jams of immense proportions. These problems were caused because the hierarchy of streets worked too well. Traffic was forced unto the main axial streets which led directly to the forum. The old-fashioned crossing at the center of Rome produced a maximum amount of needless congestion. The fact that Rome had to accommodate the movement needs of an estimated 1,200,000 people made this task all the more difficult.

> By the time of Julius Caesar, the street system was grossly overloaded, with continual conflict between pedestrian and vehicular traffic. As a result, Caesar was forced to ban transport carts from the city during the hours of daylight, with the exceptions of builders' carts and a few official chariots. During the daytime Rome was therefore largely free from wheeled traffic, but at night, . . . the crossing of wagons in the narrow winding streets and the swearing of drivers brought to a standstill would snatch sleep from a sea-calf or the Emperor Claudius himself.[30]

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[29] Ibid., p. 45.

[30] Ibid.

Around the fifth century A.D., the Roman empire had fallen completely. Western civilization declined, trade disintegrated, and the urban population returned to rural life. The technological sophistication gained in the design and construction of streets and roads became lost during the Dark Ages. It was not until the twelfth and thirteenth centuries that cities became alive again. The birth of the medieval town brought new concepts in city street design.

Medieval towns flourished because feudal lords renewed the advantages of communal existence within the protective walls that had been created. These walls were designed to protect both the church and the castles of the lord. There were usually three or four entrances, strategically located for defensive purposes. The town sites were usually developed on irregular terrain, occupying hilltops or islands (see Figure 4). The town was carefully designed to fit the natural topographic features of the area. "The circulation and building spaces were molded to these irregular features and naturally assumed an informal character."[31] All medieval towns were totally unique in plan and no two towns were alike.

> The roads radiated generally from the church plaza and market square to the gates, with secondary lateral roadways connecting them. The irregular pattern was probably consciously devised as a means to confuse an enemy in the event he gained entrance to the town. . . . In the maze of wandering streets the advantage rested with the inhabitants against an enemy unfamiliar with the arrangement.[32]

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[31]Arthur B. Gallion and Simon Eisner, op. cit., p. 38.

[32]Ibid.

Figure 4. Medieval Mantua.

Source: Edmund N. Bacon, Design of Cities (New York, New York: Penguin Books, 1974), p. 92.

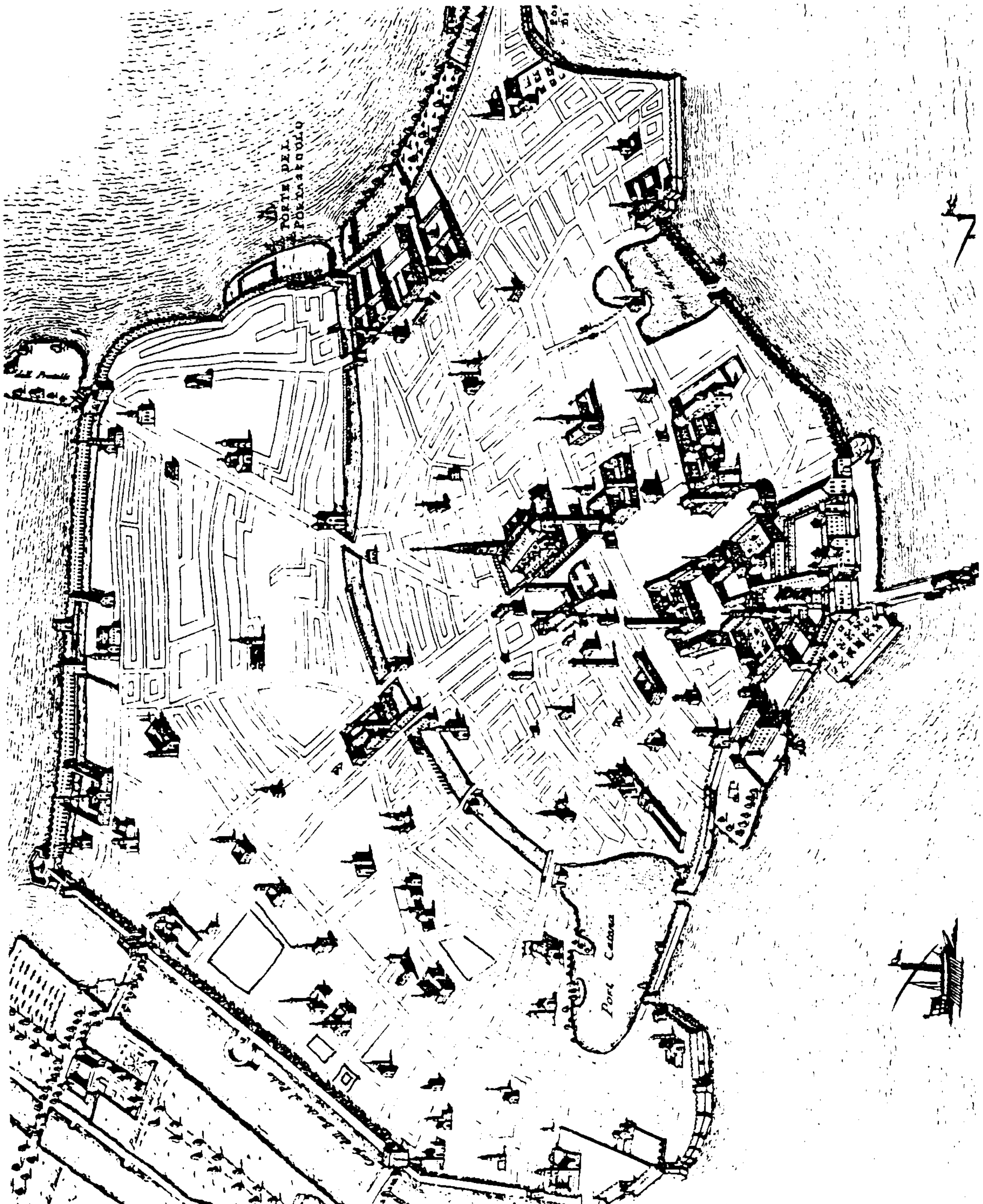


Figure 4

The street plan within the massive walls of these towns was typically designed for pedestrian movement. Wheeled transportation was considered of secondary importance.[33] "The streets were narrow and irregular in pattern as sharp turns and closures were frequent. The plan was also often designed to break the force of the wind and reduce the area of mud."[34]

During the rebirth of the medieval town in Europe, architects and town planners conceived a new type of walled town. The "bastide," a town built according to a predetermined plan, was designed with efficiency and economy in mind. The design of the street plan followed these considerations.

> Although a gridiron of streets, forming rectangular house plots, is present by definition in all bastides, there is no standard plan and in many examples the grid, often considerably distorted, is used only for a part of the town. As with the majority of applications in preceding historical periods it is a grid of convenience--the quickest and most equitable way of laying out a town on a new site. . . .
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> . . . . . .
>
> Fortifying a gridiron town created planning problems around the perimeter. Combining the rectilinear street system with a circular wall--which enclosed maximum area for a given length and in addition offered the best means of defence against medieval assault tactics--created odd-shaped plots around the perimeter.[35]

Central and South America

Thousands of miles from Europe, a civilization began to develop an extensive system of roads along the Pacific coast of South America.

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[33] Lewis Mumford, op. cit., p. 308.

[34] Ibid.

[35] A.E.J. Morris, op. cit., pp. 82-83.

The Incas developed roads that extended 2,500 miles, from Ecuador in the north to midway down the coast of Chile in the south. The Inca road system was designed and built very similar to their Roman counterparts, however, the Incas had not discovered the wheel at the height of their empire. Nonetheless, a good road system was needed to extend their conquests and to govern their empire. In many mountainous places the roads were turned into elaborate staircases. Along the coastal plains of Peru and Chile, the roads were designed to be straight and wide in order to be able to march gladiators in powerful and impressive formations.

The cities of the Incan Empire in South America along with those developed by the Mayans in Central America and the Aztecs in Mexico contained similar street design concepts as those created in China and Europe. Each of these "New World" cities developed a sophisticated gridiron system of streets in which sun orientation, religion, and architecture were factors that influenced their configuration. Every city contained at least one wide main street, usually running in either a north-south or east-west axis, in which the main religious and civic buildings were located.

The best example of the gridiron street system in Latin America could be found in the city of Tenochtitlan, Mexico, the Aztec capital.

> The plan of the city, shows the original area divided into four symmetrical parts. Each ward contained a variable number of subdivisions, remnants of an older organization, based on clans, on which the imperial state had been superimposed. The boundaries of the four original wards met at a central point, which was the area occupied by the great temple, the imperial palaces, and the homes of some of the lords. From each of these gates of the enclosure of the great temple, there ran a street that marked one of the

> boundaries of the wards. Three of these streets became causeways built of stone and supported by rows of stakes driven into the lake bottom, and thus they crossed the water to the mainland.[36]

The Renaissance in Europe

The Renaissance period of urban history is taken as extending from its commencement in Italy, at the beginning of the fifteenth century, until the end of the eighteenth century. During this time, European cities went through a revival of interest in the street designs of ancient Rome and Greece. Two main components of Renaissance planning emerged from the period: first, the primary straight street, and secondly, gridiron based districts.

> In the form of main routes emancipated from being mere access to a building plot on the one hand and an urban extension of the national highway on the other, the primary straight street is a Renaissance innovation.[37]

The function of the primary straight street was to facilitate the movement of carriages and other wheeled vehicles between parts of a city. The best example of the primary straight street still in existence is the famous Champs Elysées of Paris, France.

Lewis Mumford amplifies the significance of the application of the primary straight street on the overall design of the baroque city during the Renaissance period in Europe:

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[36]Dora P. Crouch, Daniel J. Garr, and Axel I. Mundigo, Spanish City Planning in North America (Cambridge, Massachusetts: The MIT Press, 1982), p. 37.

[37]A.E.J. Morris, op. cit., p. 107.

> The avenue is the most important symbol and the main fact about the baroque city. Not always was it possible to design a whole new city in the baroque mode; but in the layout of half a dozen new avenues, or in a new quarter, its character could be re-defined. In the linear evolution of the city plan, the movement of wheeled vehicles played a critical part; and the general geometrizing of space, so characteristic of the period, would have been altogether functionless had it not facilitated the movement of traffic and transport, at the same time that it served as an expression of the dominant sense of life. It was during the sixteenth century that carts and wagons came into more general use within cities. This was partly the result of technical improvements that replaced the old-fashioned solid wheel with one built of separate parts[38] hub, rim, spoke, and added a fifth wheel to facilitate turning.

Town planners began to understand for the first time that the streets laid out during medieval Europe were inadequately designed to handle the volumes and desires of traffic. Improvements would be needed to handle the increasing volumes of wheeled vehicles and this usually resulted in the reconstruction of many primary straight streets.

> The introduction of wheeled vehicles was resisted, precisely as that of the railroad was resisted three centuries later. Plainly the streets of the medieval city were not adapted either in size or in articulation to such traffic. . . . Nevertheless,[39] the new spirit in society was on the side of rapid transportation.

The wide primary straight street was also viewed as an expression of spaciousness within the midst of a densely developed city. Movement in a straight line along primary straight streets was not merely an economy but a special pleasure: "it brought into the city the stimulation and exhilaration of swift motion, which hitherto only

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[38] Lewis Mumford, op. cit., pp. 367-368.

[39] Ibid., p. 368.

the horseman had known galloping over the fields or through the hunting forest."[40]

Again, as in centuries before, many cities of the Renaissance incorporated the needs of the army. The design and reconstruction of many primary straight streets further emphasized the military orientation of the government and people. Town planners of the time observed that

> . . . the ways will be short and convenient if planned in a straight line, and so large that horses and coaches be no hindrance to each other when they meet, . . . the ways will be more convenient if they are made everywhere equal; that is to say, that there be no place in them where armies may not easily march. . . .
> . . . . . .
> In view of the importance of the army to the ruling classes, it is no wonder that military traffic was a determining factor in the city plan, from the first mutation in Alberti to the final survival in the laying down of Haussmann's boulevards in Paris.[41]

The second important design component created during the Renaissance was the re-application of the gridiron.

> During the Renaissance period in Europe three main uses are made of the gridiron, history's oldest known urban form regulator: first, and by far the most widespread, as the basis of residential districts added to existing urban areas; second, for the entire layout of a limited number of new towns; third, in combination with a primary street system, for the layout of other new areas.[42]

Figure 5 is a plan of the city of Nancy, France. The plan shows how a gridiron addition was applied to the original irregular street patterns of medieval Nancy.

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[40] Ibid.

[41] Ibid., p. 369.

[42] A.E.J. Morris, op. cit., p. 108.

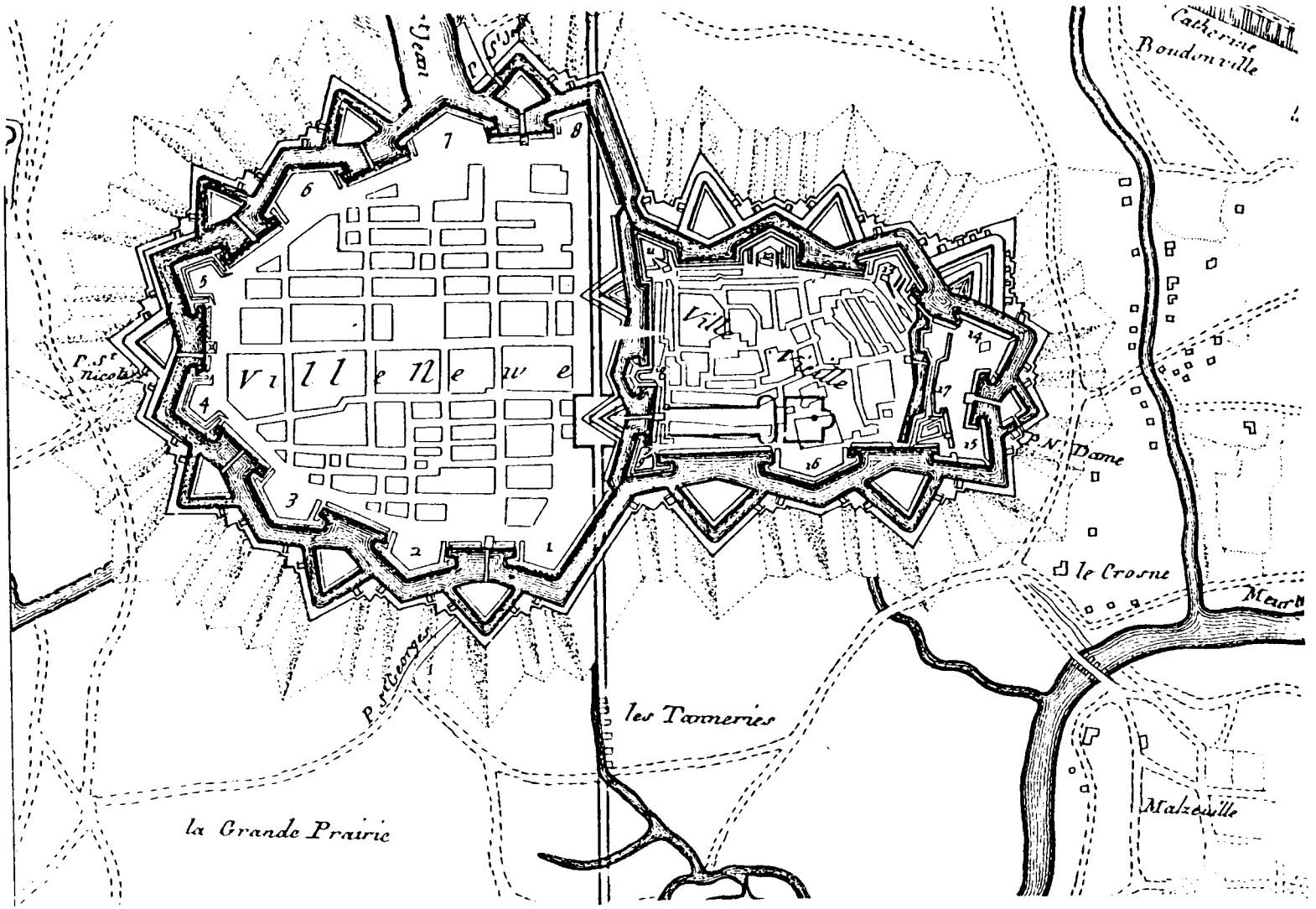


Figure 5. Renaissance Nancy.

Source: Edmund N. Bacon, Design of Cities (New York, New York: Penguin Books, 1974), p. 176.

> Because of the comparatively greater area that they covered, gridiron districts, in contrast to primary streets and enclosed-space components, are seldom found in redeveloped parts of Renaissance cities. In addition to being efficient and producing an equality of land subdivision--the same reasons for its use in preceding historical periods--the gridiron also conformed to the Renaissance ideal of aesthetic uniformity, even if the resulting townscape all too frequently reveals this to be mere monotony.[43]

Renaissance cities also refined the definition of street hierarchy. This became necessary because the hierarchy established by the Romans centuries before had become outdated. The increasing numbers of citizens and wheeled vehicles forced local governments to make adjustments to the overall system. The three new divisions were:

> . . . first, traffic space, forming part of the main urban route system and used by both pedestrians and horsedrawn vehicles; second, residential space, intended for local access traffic only and with a predominantly pedestrian recreation purpose; and third, pedestrian space, from which wheeled traffic was normally excluded.[44]

Although its application was relatively limited during the Renaissance, the design of walled fortification cities is interesting. A number of famous Italian, French and English urban planners, architects and scientists, including Leonardo da Vinci, attempted to design the "ideal fortified city." The principles of street design that were used were extremely varied. For example, Vitruvius designed a town of radial-concentric form, enclosed within an octagonal wall. Eight radial streets lead out to the angle towers rather than to the

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[43] Ibid.

[44] Ibid., p. 109.

gateways in the center of the sides.[45] "Vitruvius advised this approach to avoid adverse winds. The town would have had valuable defensive military advantages in that the gateways did not give direct access to the center of town."[46]

In contrast, Leon Battista Alberti, preferred wide straight streets in order to enhance the majesty of important cities and to facilitate movement, particularly of soldiers. But Alberti "also saw advantages in winding medieval streets; these minimised the effects of climatic extremes, assisted internal defence, and allowed each of a sequence of individual buildings to be clearly presented in view."[47]

The basis of Antonio Averlino's plans consists of two squares overlaid on each other to create an octagon within a circular perimeter. "From the center of the city sixteen radial routes lead out to the perimeter."[48] What makes his designs of particular interest is the invention of an intermediate ring road which connects secondary squares with the radial routes.

Vincenzo Scamozzi, designer of Palma Nova in Italy, incorporated into his design the use of a full gridiron, a hierarchy of public squares and spaces, and the introduction of a canal waterway system.

> The function of Palma Nova was to be a fortified garrison outpost of Venice's defenses. Its perimeter is a nine-sided polygon

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[45] Ibid., p. 114.

[46] Ibid.

[47] Ibid., p. 115.

[48] Ibid.

> and its central square a regular hexagon. These shapes are resolved into an integrated pattern by a complex arrangement of radial streets; six lead out from the center to an angle of the wall, or, alternatively, to the center of the side [see Figure 6].[49]

Sixtus V, another designer of the ideal fortified city, concentrated on using his street design principles for Rome. Sixtus V redesigned some of Rome's streets in order to link the seven pilgrimage churches via wide boulevards. He was aware of the role the new streets could play in generating growth in the largely uninhabited eastern and south-eastern districts of the city.

The Renaissance period in Europe was an era of innovation and experimentation. This is clearly exemplified in the many unusual street designs implemented during this time. Some of the ideas were very successful, others not so successful.

The magnificent boulevards designed and built in Paris, France, came about in a very unusual manner. With the fortification walls in poor repair, Louis XIV ordered many of these walls demolished. These wide walls were cleared and levelled, forming a natural way for the construction of many wide boulevards. By definition, "the boulevard is the line of fortifications itself but when these were converted into wide tree-lined streets the designation boulevard was kept and today the word seems simply a broad tree-lined avenue."[50] Unusual too was the fact that the outer ring of Paris' boulevards became the limit for

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[49]Ibid., p. 118.

[50]Ibid., p. 145.

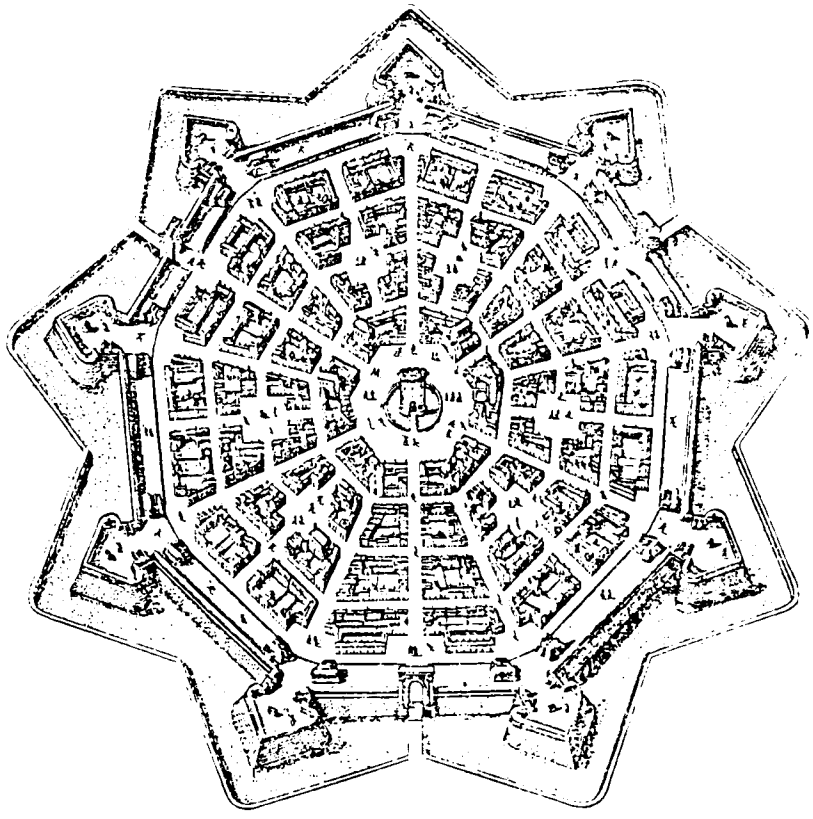


Figure 6. Renaissance Palma Nova.

Source: A.E.J. Morris, History of Urban Form, Prehistory of the Renaissance (London, England: George Godwin, Ltd., 1972), p. 117.

growth, beyond them building was forbidden. These ideas were practiced in many other European cities as the need for defensive walls were lessened.

Paris' street design today was also immensely affected by the work of Baron George-Eugene Haussmann, working under Napoleon III's supervision. He put together an incredible reconstruction program, in which a new system of wide straight boulevards were built. "The entire boulevard system for Paris was planned and executed in a period of seventeen years" (see Figure 7).[51]

> Haussmann was aware of the need to design for the traffic of a new industrial age. He laid out the new streets in long sweeps cutting through the maze of winding medieval lanes. With these avenues he connected old plazas and created new plazas.[52]

Edmund Bacon felt that

> . . . the achievements of Baron Georges Haussmann led to the reintegration of the heart of Paris and a strengthening of its interior structure on a scale commensurate with the forces of regional expansion. This reversal of the direction of energy, from the outward explosion of the avenues and palaces of the Louis Kings to the implosion of the connecting and life-giving boulevards of Haussmann, is one of the most dramatic in any city.[53]

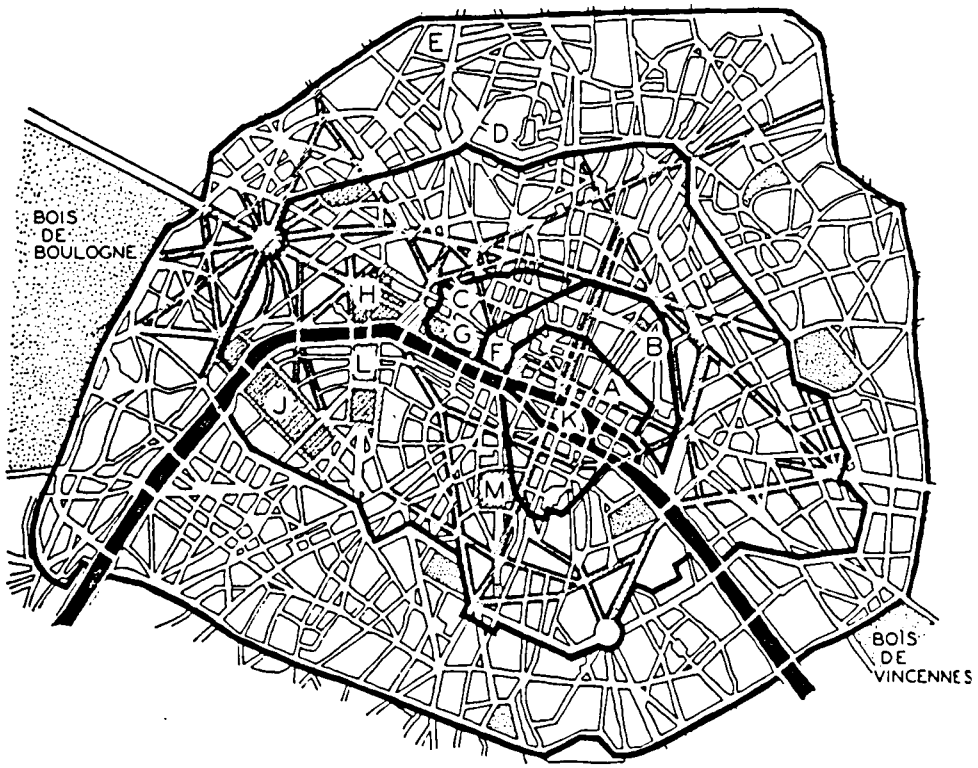
The design and layout of Amsterdam's street system was also made possible through some innovative techniques. Amsterdam, lying in the

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[51]Arthur B. Gallion and Simon Eisner, op. cit., p. 83.

[52]Ibid.

[53]Edmund N. Bacon, Design of Cities (New York, New York: Penguin Books, 1974), p. 191.



The dark-shaded streets show
the Haussmann Program

Wall **A** Built by Philip Augustus, Twelfth century
Wall **B** Built by Charles V, Fourteenth century
Wall **C** Built by Louis XIII, Seventeenth century
Wall **D** Built by Louis XV, Eighteenth century
Wall **E** Built by Napoleon III, Nineteenth century
F The Louvre
G The Tuilleries
H The Champs Élysées
J The Champs de Mars
K The Île de la Cité
L The Invalides
M The Luxembourg

Figure 7. Renaissance Paris.

Source: Arthur B. Gallion and Simon Eisner, The Urban Pattern, City Planning and Design (New York, New York: D. Van Nostrand Company, 1975), p. 84.

lowlands next to the Amstel River, built a system of dikes to control flooding. These dikes also served as main circulation routes for all the land traffic in the city. The dikes plus the system of canals greatly influenced the configuration of Amsterdam's patchwork gridiron street system and surrounding road network.

St. Petersburg (now Leningrad), Russia's street plan was based entirely on the location and placement of the tower of the Admirality.[54] In the immediate vicinity of the tower there was a combination of radial and gridiron streets which followed the example of the town area of Versailles in France.[55]

Mannheim, Germany, can be viewed as a Renaissance city which was an innovative failure.

> The general gridiron street pattern was modified by the slightly wider main axis-streets in front of the palace and by the broad cross avenue. Two of the street blocks were left open as, at most, only incidental public open space.[56]

Critics of Mannheim's attempt to be creative and unique declared that the grid plan of the city

> . . . was carried out already with an unrelenting thoroughness at Mannheim, whose plan looks like a chequerboard; there exists not a single exception to the arid rule that all streets intersect perpendicularly and that each one runs straight in both directions until it reaches the countryside beyond the town. The rectangular city block prevailed here to such a degree that even street names were considered superfluous, the city blocks being designated

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[54] A.E.J. Morris, op. cit., p. 171.

[55] Ibid.

[56] Ibid., p. 172.

> merely by numbers on one direction and by letters in the other. Thus the last vestiges of ancient tradition were eliminated and nothing remained for the play of imagination or fantasy.[57]

The street plan of London, England, was an accumulation of many major factors which significantly affected the overall design of the city. London was a typical medieval city with narrow, meandering streets and lanes.

> The street system was as obsolete as the buildings, which had gradually encroached on to the thoroughfares. It was totally unsuited to London's newly assumed role as a leader of world trade. The narrow, tortuous lanes leading down to the wharfs had already failed to accommodate packhorse traffic and could not possibly deal with the growth of cart and dray transport. . . . Attempts were made to control this traffic by licensing, broad wheels were made compulsory, and the number of horses was limited.[58]

The Great Fire of London in 1666 changed all that. Two weeks after the fire, the king published a proclamation in which he set out "the decisions for the immediate present and his intentions for the future."[59] Important streets were to be widened in order to constitute firebreaks for the city. "The network of inconvenient and unhygienic lanes was to be replaced by wider streets."[60]

Sir Christopher Wren, an architect, was chosen to design the new plan for London. He recommended "that all street corners should

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[57] Ibid.

[58] Ibid., p. 188.

[59] Ibid., p. 189.

[60] Ibid.

preferably be rectangular."[61] The city's commissioners "determined the street widths of the city as: Key, 100 ft.; high streets, 75 ft.; some other streets 50 ft. and others 42 ft.; the least streets 30 ft. or 25 ft.; alleys, if any, 16 ft."[62]

> The Wren plan, in common with the others, would certainly have improved the street system, particularly the east-west routes, and it is competently related to the streets giving access to the City. But it would have suffered from the usual defects of a plan that imposes radial streets on a basic grid pattern.[63]

Unfortunately much of the Wren plan was never implemented. "The post-1666 street pattern was essentially a restatement of the old system, with its capacity greatly increased."[64]

Around 1800, London officials decided that major improvements to the city's recreation and transportation facilities were needed. John Nash was requested to design the needed changes. First, he designed and constructed the magnificent Regent's Park. Next, he designed Regent Street to serve as a connector between the new park and its adjacent development with Carlton House (the residence of the Prince Regent).[65]

> Nash envisioned the street as a connector between the jumbled pattern of the Soho area around Golden Square to the east, and the

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[61] Ibid., p. 191.

[62] Ibid., p. 193.

[63] Ibid., p. 191.

[64] Ibid., p. 193.

[65] Edmund N. Bacon, op. cit., p. 209.

formal, organized, aristocratic section relating to Cavendish and Hanover Squares to the west.[66]

The Industrial Revolution and the New Town Movement

During the nineteenth and twentieth centuries the world experienced the dawning and growth of the Industrial Revolution and the New Town Movement. Both of these eras influenced the design of streets and street patterns in cities. The Industrial Revolution saw the invention of the steam engine along with mechanical power change the physical composition of the city. New "high-rises" with substantial volumes of floor space for factory, office and residential uses placed a heavy burden on the streets below. Increased land use densities made congestion a serious problem in all major cities. Street design maladies began to become apparent.

Also, the steam engine's development made it possible for the invention and creation of new forms of transportation. Invented during the nineteenth century were the railroad, steamship, automobile, and streetcar, plus a variety of other similar vehicles. All of these modes, except the steamship, significantly influenced the design of city streets. As is obvious today, the automobile eventually dominated the urban transportation scene around the world and single-handedly created the largest impacts on street and highway design. The influx and integration of all of these modes generally made existing traffic problems worse, and technically more complex. These problems are examined in greater detail in the discussion of street pattern design for cities in the United States.

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[66]Ibid., p. 208.

The impact of the industrial revolution was first felt in England. The new industrial economy brought exploitation of the poor and, with poverty, came the slums. "The depressing condition of housing for the poor impressed some industrial leaders who sensed the problems it presented to the future of the industrial economy."[67] As a result, a number of utopian, model towns or "company" towns, and new towns were proposed and subsequently built to rid the workers of unsanitary living conditions. All of these projects were part of the New Town Movement. The street plans for these new cities are interesting and worth examining in greater detail.

The New Town Movement produced a wide variety of plans in England and in many other European countries. The towns were designed to be an antithesis of the congested, polluted industrial city. Almost all of these new cities were relatively small in size and acreage, designed to encourage pedestrian circulation and maintain close proximity to surrounding open space. The plans typically indicated an abundance of open space flowing throughout the community as separations between the neighborhoods.

Probably the most famous of the new town designers was Ebenezer Howard. He conceived of the concept of a "Garden City," a city which would provide a living environment in which the citizenry would be in close proximity with nature once again. He designed the Garden City to be a town with a permanent green belt located on the exterior in order to limit the growth of the city, and to protect it from invasion and encroachment of London's burgeoning population.

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[67]Arthur B. Gallion and Simon Eisner, op. cit., p. 72.

The street plan for the Garden City (see Figure 8) was to incorporate

> . . . six magnificent boulevards--each 120 feet wide--traverse the city from centre to circumference, dividing it into six equal parts or wards. In the centre is a circular space containing about five and a half acres, laid out as a beautiful and well-watered garden.[68]

Ebenezer Howard's Garden City street plan also contained a number of ring roads of varying widths which intersected the six boulevards at near right angles.

Ebenezer Howard was able to watch his concepts be transformed into physical realities as the cities of Letchworth and Welwyn were built (see Figures 9 and 10). While these cities did not copy the Garden City concentric circle design concept, the elements remained visible through other design schemes. Welwyn, for example, contained a street plan in which four main roads join together in a central circle but the supporting street system was organic and curvilinear. Welwyn was also one of the first cities in Europe to use the cul-de-sac and loop street concepts effectively in the design of the city's street system.

Another interesting street design concept generated during the New Town Movement included the Linear City. Senor Soria y Mata's proposal for a new town was based on the idea that the city would be built along a spinal rapid-transit system and wide boulevards. The

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[68]Ebenezer Howard, Garden Cities of To-Morrow (Cambridge, Massachusetts: The MIT Press, 1965), pp. 51, 53.

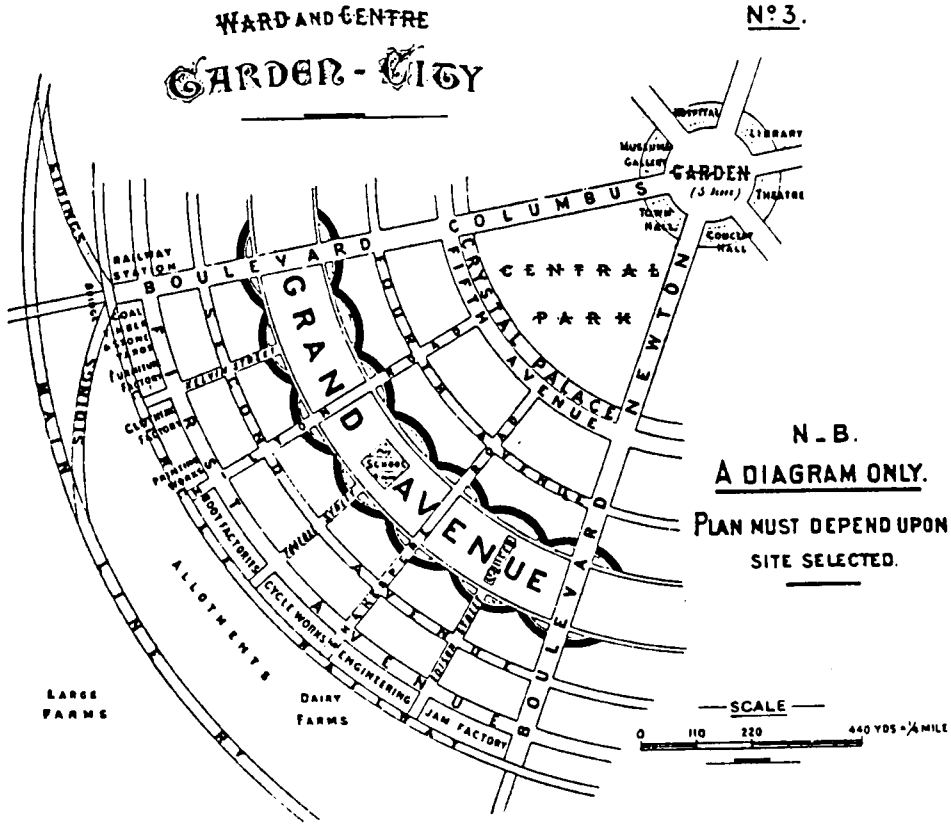


Figure 8. Ebenezer Howard's Garden City.

Source: Ebenezer Howard, Garden Cities of To-Morrow (Cambridge, Massachusetts: The MIT Press, 1965), p. 53.

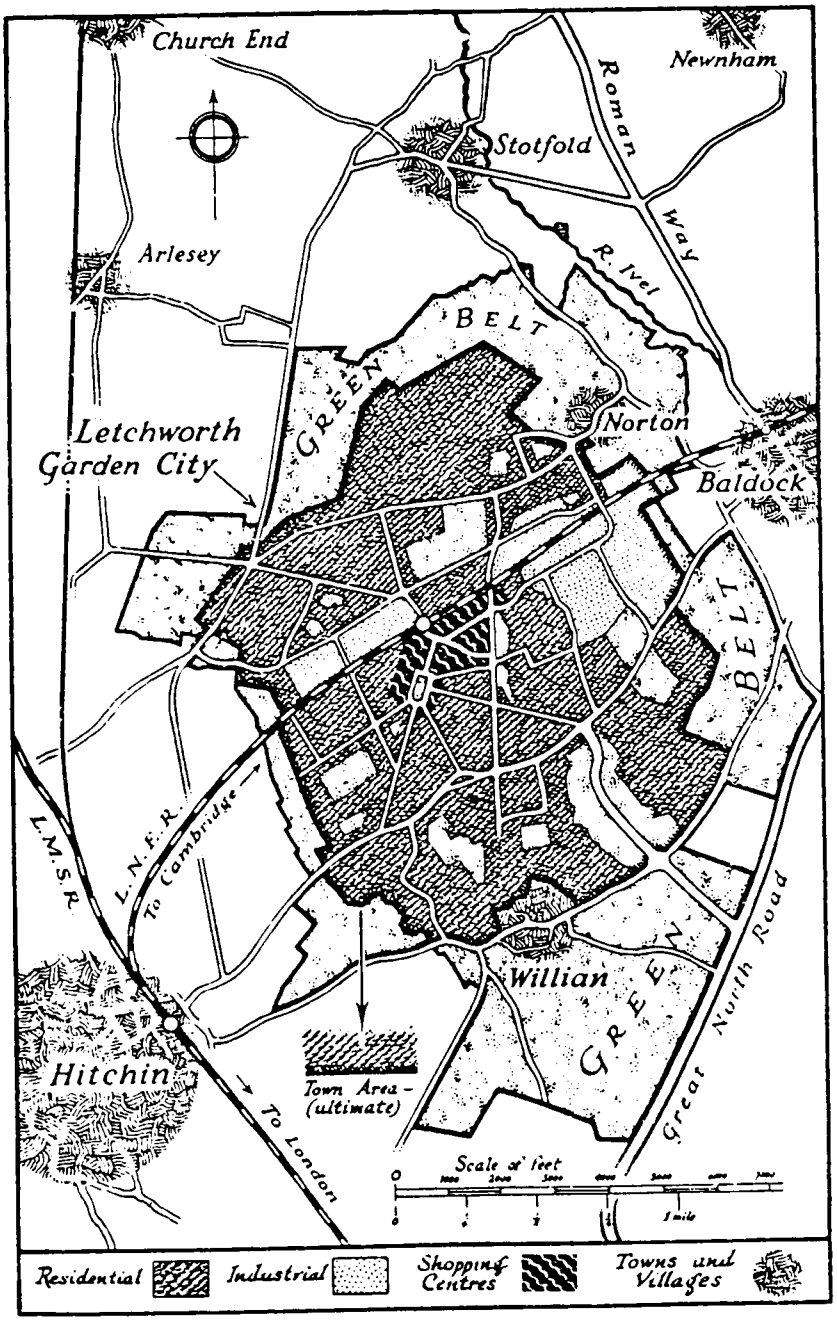


Figure 9. Letchworth Garden City.

Source: Ebenezer Howard, Garden Cities of To-Morrow (Cambridge, Massachusetts: The MIT Press, 1965), p. 105.

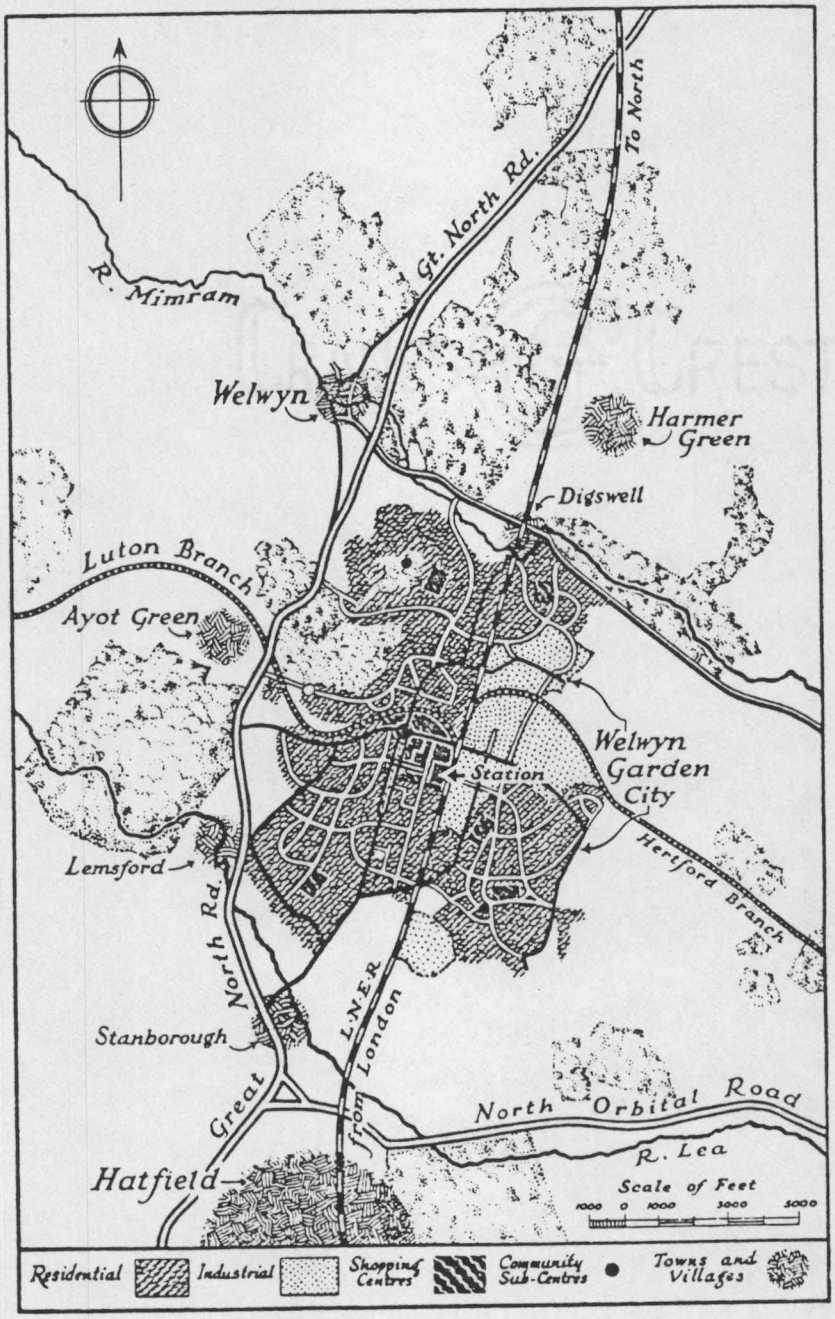


Figure 10. Welwyn Garden City.

Source: Ebenezer Howard, Garden Cities of To-Morrow (Cambridge, Massachusetts: The MIT Press, 1965), p. 129.

remainder of the city would be gridiron in configuration and would feed into the central transportation lines. His 1882 design was intended to serve as a link between existing cities in which development would be controlled along a corridor rather than in the countryside.

Dealing with the Automobile

As the popularity of the automobile took hold in England, and in many other European and non-European countries around the world, national leaders began to recognize the need for solutions to the problems of urban traffic congestion. Sir Herbert Alker Tripp, in his book Town Planning and Road Traffic, said that the cause of many of these traffic ills "originates in unsuitable layout; the problem is fundamentally one of design and planning."[69]

Two broad approaches were taken to deal with the rising popularity of automobile travel in these urban areas. First, as previously discussed, a variety of new towns were developed away from these urban areas with the hope that this would reduce urban congestion. As we know, the decentralization of these large urban areas often did not reduce the problems of urban traffic congestion but just gave it a chance to grow elsewhere. Second, many cities chose to develop efficient mass transit systems in order to transport the masses. While the construction of these facilities was taking place, civic leaders also attempted to correct the problems of a poor surface street pattern.

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[69]Sir Herbert Alker Tripp, Town Planning and Road Traffic (London, England: Edward Arnold and Company, 1942), p. 16.

The new town approach introduced a variety of unique solutions to the automobile problem. For example, with the creation of Brazilia, Brazilian architect Lucio Costa designed the city along two huge axes, in which a majority of traffic would be grade separated. While the design concept is bold, it is a failure in application. Poorly designed interchanges and surface street systems along with masses of Brazilian-produced automobiles ruined this "fresh start" at city street pattern planning and design. Utopian architect LeCorbusier also attempted to design new cities which would deal with the problems of automobile movement. His concepts of separating through traffic and local traffic were ingenious for his day, however, almost all of his designs were never used because of the significant monetary and social costs which would have occurred. Many other famous architects and city planners also made attempts to create the perfect new town. However, Sir Herbert Alker Tripp chastised these plans by saying:

> From a traffic point of view there can be no inherent value in any new town which is symmetrically perfect, if that symmetry can only be seen from the clouds. Such town plans are attractive on the drawing-board, but are not really useful in practice.[70]

> Any new town plan which is on inspection found to be defined mainly in terms of road layout. The road layout becomes--so to speak--the skeleton of the body. If it is ill designed, the whole town plan is permanently deformed: the new layouts, once built, are hopelessly rigid, and a great opportunity has been lost.[71]

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[70] Ibid., p. 37.

[71] Ibid.

In tackling the inherent problems of poor street layout and design, European city planners attempted to create a variety of solutions tailored for a combination of pedestrian and motorized movements. The problems of large, multi-legged intersections were dealt with through the creation of traffic circles or "roundabouts." The first roundabouts built were much too small. Their narrow dimension enabled vehicles, when traffic was light, to take the roundabout at speeds which were too high, and the vehicles entered from the several streets crossed one another's tracks so sharply that the movements amounted to a very definite cut. The Germans attempted to deal with the difficult and poorly designed intersections by means of fly-over junctions. The major drawbacks of this solution are its high cost and its appearance in the urban setting. Of the two solutions defined, the roundabout has been used primarily, however, its application in urban settings today has in some cases made traffic movements that much more difficult.

British transportation planners can lay claim to two additional solutions to the difficulties of poor street design and layout. These are: 1) the introduction of a system of one-way streets upon the existing configuration, and 2) the development of new high speed roads called "parkways."

Traffic planners in London and Birmingham, England, felt that through the creation of a one-way system of streets "one-way workings are extremely useful in making the best of a bad job where cramped layouts are now carrying three or four times the amount of traffic for

which they were built."[72] Those same planners also attempted to deal with the ever-increasing traffic congestion problems by building many parkway-like facilities to the suburbs and country. These facilities were intended to ease the traffic burdens on already overloaded local and arterial streets by providing a route which would allow high speeds with a minimum of interruption.

British new town planners during the 1940's attempted to alleviate the known problems of poor street design and layout by establishing guidelines in the development of a new town's street pattern. The essential features of the layout, from a traffic point of view, can be summarized as follows:

1. The general plan should be on the radial plus circular system, but perfect symmetry is of no practical value so long as the general idea is followed.[73]
2. A circular road of extreme merit must surround the centre and heart of the city.[74]
3. The traffic arteries must be roads dedicated to transit, first, last, and all the time. There must be no frontages, no loading and unloading, no standing vehicles and no pedestrians.[75]
4. The main arterial system will communicate, by means of large roundabouts, with a system of sub-arterial roads.[76]

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[72] Ibid., p. 52.

[73] Ibid., p. 54.

[74] Ibid.

[75] Ibid.

[76] Ibid.

5. The local roads will communicate with one another and with the sub-arterial roads--never directly with the main arteries. Where local roads have to cross a traffic artery they must do so by bridge or tunnel.[77]

6. All road junctions in the system of local roads will be staggered.[78]

7. Business, shopping, industrial and amusement centres will be in places where there is no through-traffic.[79]

The elements described here are refinements of the original "Garden City" concept created by Ebenezer Howard some fifty years earlier. While not all of the ideas are feasible, they nonetheless required the traffic planners to think of the total street patterns as an entire functional system.

B. STREET AND HIGHWAY DEVELOPMENT IN THE UNITED STATES

Street and highway development in the United States can be traced back to the time when the nation was discovered in 1492. Christopher Columbus built a crude fortress from the timbers of the wrecked Santa Maria on the northern coast of the island of Espanola (now the modern Santo Domingo). Within this fortress a gridiron pattern of streets emerged. Although the settlement did not survive, the street system designed for the fortress set a pattern that was widely employed by the Spanish throughout the New World and copied for hundreds of years thereafter.

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[77] Ibid., p. 56.

[78] Ibid.

[79] Ibid.

Santo Domingo was rebuilt in 1502, under the direction of Nicolas de Ovando, the governor of Spain. Once again Santo Domingo incorporated a gridiron street pattern. As early as 1526 Gonzalo Fernandez de Oviedo y Valdes, one of the earliest Spanish historians of the first years of colonization and himself intimately familiar with Santo Domingo described the city in these words:

> Concerning Santo Domingo. . . . The general layout of the city is much better than that of Barcelona, because the many streets are more level and wide and incomparably straighter. Since the city was founded in our own time, there was opportunity to plan the whole thing from the beginning. It was laid out with ruler and compass, with all the streets being carefully measured.[80]

While the Spanish continued their exploration and settlement of the New World, American Indians had already explored and settled in the great expanse of land that is now the United States. It is generally believed that in their travels across the great land, American Indians developed an extensive system of trails and narrow paths. These trails, often only a few feet wide, were usually developed along the ridges of hills where possible. The trails along these ridges stayed dry and gave a better view of the land. Many trails were also made by migrating herds of animals which were later adopted by these nomadic Indian tribes. While these Indian trails were not always the shortest route, they were easier to use, and so the explorers and settlers from Europe gradually made many of them

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[80]John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), pp. 24-25.

into roads. A full discussion of road and highway planning and design in America will be presented later in this chapter.

The Laws of the Indies

In 1565, the city of St. Augustine in Florida was established by Spain as the first permanent settlement in the continental United States. A few years later, in 1573, the Spanish authorities drew up the first settlement policy for the establishment of hundreds of new cities in the new land. This new policy was embodied as the "Laws of the Indies." Philip II, the King of Spain, proclaimed the Laws of the Indies to establish uniform standards and procedures for planning of towns and their surrounding lands as well as for all the details of colonial settlement. While parts of these royal ordinances established new requirements and regulations, virtually all of the sections governing town planning represented a mere codification of practices that had become fairly standardized since the establishment of Santo Domingo.[81]

> The regulations of 1573 can be regarded as the first American planning code. Many aspects of urban planning are included, starting with site selection and dealing at length with urban form. The plan of the place, with its squares, streets and building lots, was to be outlined by means of measuring by cord and ruler, beginning with the main square from which streets were to run to the gates and principal roads and leaving sufficient open space so that even if the town grew it could always spread in a symmetrical manner. Without specifically defining a gridiron street structure it is obvious that this is what the code required: the most characteristic aspect of American urbanism is thus already being introduced.[82]

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[81] Ibid., p. 27.

[82] A.E.J. Morris, op. cit., p. 214.

The Laws of the Indies also contained other requirements which affected the design and layout of the gridiron street pattern:

> The main plaza was to be oriented so that its four corners pointed to the four cardinal points of the compass. This feature was designed to prevent exposure "to the four principal winds" which would otherwise result in "much inconvenience." In other parts of the towns, smaller "well proportioned" open spaces were to be provided as sites for churches and other religious buildings.[83]

> From the main plaza principal streets were to lead from the middle of each side, with two minor streets diverging from each corner. . . . The whole plaza and the four main streets diverging from it shall have arcades, for these are of a great convenience for those who resort thither for trade. The eight streets which run into the plaza at its four corners are to do freely without being obstructed by the arcades of the plaza. These arcades are to end at the corners in such a way that the sidewalks of the street can evenly join those of the plaza.[84]

> In cold places the streets shall be wide and in hot places narrow; but for purposes of defense in areas where there are horses, it would be better if they were wide.[85]

> The streets shall run from the main plaza in such manner that even if the town increases considerably in size, it will not result in some inconveniece that will make ugly what needed to be rebuilt, or endanger its defense or comfort.[86]

The development of these ordinances have origins dating back to the days of the Roman Empire. The grid system of city planning had been introduced in Spain during the Roman conquest of the Mediterranean. Dozens of Spain's major cities can attribute at least

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[83]John W. Reps, op. cit., p. 28.

[84]Ibid., pp. 28-29.

[85]Dora P. Crouch, Daniel J. Garr, and Axel I. Mundigo, op. cit., p. 14.

[86]Ibid.

their cores to Roman street planners and designers. Philip II, as well as many of his predecessors, became influenced by the beautiful city street designs of Vitruvius, the noted Roman city planner. However, one important difference exists between Vitruvian city street designs and those created by the Spanish. Vitruvius, as previously mentioned, designed his ideal street pattern in a radial configuration with eight main streets converging on a central plaza. The Spanish government did not include this design requirement within the Laws of the Indies because it was felt that radial streets would be too difficult for amateurs to lay out.[87]

> We think the grid was chosen because it had worked well for the Romans and also because it can be easily applied by people without any previous experience in the founding or laying out of cities. No special symbolic significance is or should be attached to the gridiron plan; rather, it should be seen as one of the more practical elements of a cluster of ingredients that were being implemented in a more or less standard form by those defining the future urban shape of the New World.
>
> The Laws of the Indies--in particular, ordinances 115-118--include details concerning town layout but do not actually prescribe street patterns. Apparently, the pervasive grid was adopted spontaneously as the simplest way to carry out the Laws' provisions, and came to be universally applied as if it had been required. Thus a gridiron or checkerboard plan resulted from the combined application of royal edicts and the perceived advantages of such a plan.[88]

Discussion of individual cities which developed under the influence of the Laws of the Indies are included later in the examination of western city street design.

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[87] Ibid., p. 33.

[88] Ibid., p. 41.

The Gridiron in American Colonization

While the Spanish were developing a series of gridiron cities along the coast of the Gulf of Mexico, colonists from England were beginning to explore and settle along the coast of Virginia. At Jamestown, England finally succeeded in gaining a toehold on the new continent and began 170 years of colonization and town building. Under the authority of the Royal charter, English colonists were instructed to "set your houses even and by a line, that your houses may have a good breadth, and be carried square about your market place. . . ."[89] Like the Laws of the Indies, the instructions given to the colonists did not state specifically to develop cities with gridiron street patterns, however, the intent was very clear.

The Virginia Act of 1662 was created to provide some guidelines for the development of new towns in the colonies. The act became the precedent for a whole series of legislative enactments in Virginia and Maryland. Included in the legislation were provisions for the physical layout of a town's street system.

> A simple grid system was evidently regarded as the logical plan for these new towns in Virginia. At Yorktown there was a main street running parallel to the shore of the York River crossed by eight shorter streets leading back to the River. Tappahannock, which became the county seat of Rappahannock and later Essex County, had a more regular plan. One entire block of four lots were set aside for public use. Three different street widths were used, with the widest streets flanking the public square and dividing the town in half being 82-1/2 feet wide. Three other streets were 66 feet wide, with two narrower "lanes" being 49-1/2 feet in width.

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[89] John W. Reps, op. cit., p. 74.

> Marlborough on the Potomac in Stafford County no longer exists, although it enjoyed a brief period of prosperity. The plan is a curious one, probably originating from the uncertainty over which shore line to follow as the main axis for the town. Evidently they decided to use both, with the result that the blocks and lots are parallelograms, without a right angle to be seen [see Figure 11].[90]

"All of the colonial cities and towns were planned communities in origin."[91] The surveying and pre-planning of these cities was very important in guaranteeing their success despite the history of famine, disease, misfortune and disappointments which plagued the colonization movement to America. Despite these problems, colonial town planners often designed cities with specific social and economic objectives in mind. The gridiron street pattern was often used as the means for obtaining these objectives in these planned communities.

> When street plans for colonial cities were laid out on paper it was always understood that some of the future inhabitants would be wealthier and of higher social rank than others, and different areas were provided for spacious estates and more modest accommodations. In at least one case (Swansea, Massachusetts), the original plan specified areas for these denominated ranks.[92]

Considered to be the best of the colonial planned communities, Philadelphia, Pennsylvania, and Savannah, Georgia, influenced the design and layout of hundreds of other cities and towns built in the east, south and midwest. Perhaps because they were principal ports of entry into America, Philadelphia and Savannah's gridiron street plans

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[90] Ibid., p. 81.

[91] Charles N. Glaab and A. Theodore Brown, A History of Urban America (New York, New York: MacMillan Publishing Company, Inc., 1976), p. 6.

[92] Ibid., p. 4.

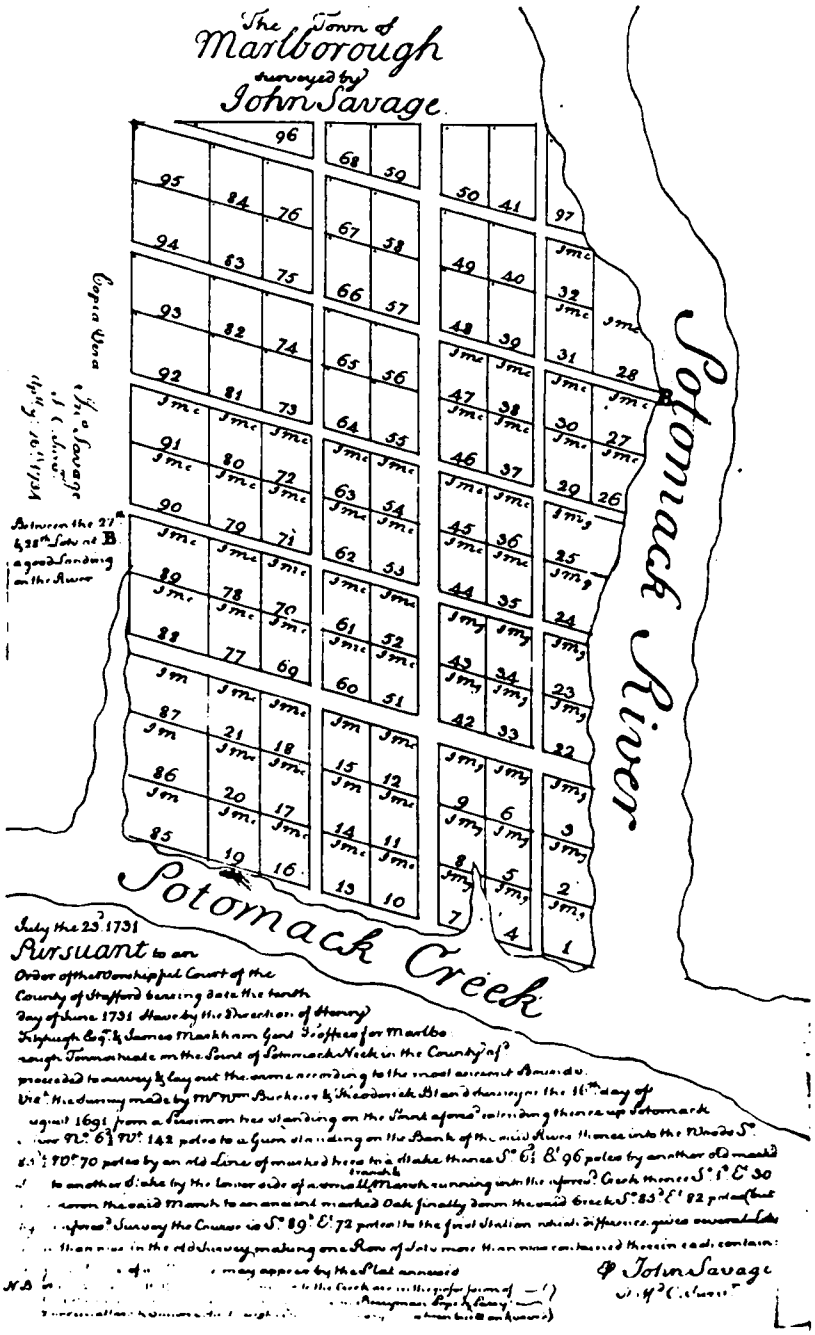


Figure 11. Marlborough, Virginia.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 84.

were often copied and laid out as miniature replicas of these two cities.

In 1681, William Penn was granted a charter establishing his authority as governor and proprietor of Pennsylvania.[93] One of his first tasks as governor was to locate and establish a new capital city, Philadelphia. Penn selected three commissioners to accompany the first group of settlers to America. To them he handed a long and detailed memorandum of instructions dealing with the establishment of his proposed city. Once the site was selected, the commissioners were to proceed with the planning and layout of the city. Penn was quite definite in specifying a regular street pattern and uniform spacing of buildings:

> Be sure to settle the figure of the town so as that the streets hereafter may be uniform down to the water from the country bounds; let the place for the storehouse be on the middle of the key, which will yet serve for market and statehouses too. This may be ordered when I come, only let the houses be built in a line, or upon a line, as much as may be. . . .[94]

Penn's experience in the planning of gridiron towns came a few years earlier as he had been closely involved in the establishment of Burlington and Perth Amboy, two communities in the Jersey colonies. Both towns were designed with a very basic gridiron pattern, however, these were much smaller in scale than that of Philadelphia.

In the Spring of 1682 Penn appointed Captain Thomas Holme

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[93]John W. Reps, op. cit., p. 141.

[94]Ibid., p. 143.

Surveyor General of Philadelphia.[95] Holme arrived at the site the commissioners had selected between the Delaware and Schuylkill Rivers and began the work of planning the city. Between June and September, 1682, Holme and the commissioners were busy with the design and layout of Philadelphia. Penn himself arrived in October, 1682, and contributed to the final plan (see Figure 12).

> The major features of the Philadelphia plan were 1) a gridiron street system, 2) a system of open spaces, and 3) uniform spacing and setback for the buildings. The gridiron pattern consisted of nine streets from river to river, and 21 streets perpendicular to them. Considering European standards, the 50-foot street was quite generous. Furthermore, the two streets intersecting at the center of the town were made 100 feet wide. A central square of 10 acres was placed at the intersection of these two major arteries.[96]

The street design instructions relayed by Penn to Thomas Holme and the commissioners were influenced by the design and reconstruction work occurring in London, England, at the time. Penn's plan for Philadelphia closely resembled Richard Newcourt's design that was submitted to the king for the rebuilding of London after the great fire of 1666.

> The scale of the plans for London coincided almost exactly with that of Philadelphia. Newcourt's scheme, for example, was for an area approximately one by one and a half miles, a tract nearly the size of Philadelphia's great grid.[97]

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[95] Ibid., p. 144.

[96] William I. Goodman and Eric C. Freund, eds., Principles and Practice of Urban Planning (Washington, D.C.: International City Managers' Association, 1968), p. 9.

[97] John W. Reps, op. cit., pp. 145, 147.

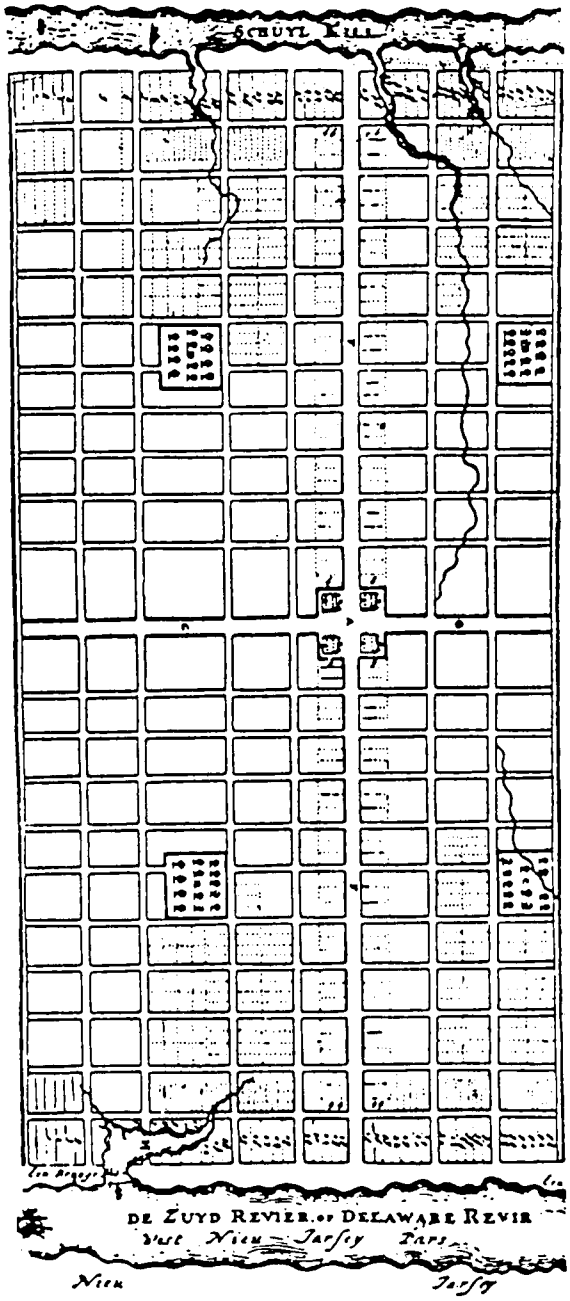


Figure 12. Philadelphia, Pennsylvania.

Source: A.E.J. Morris, History of Urban Form, Prehistory to the Renaissance (London, England: George Godwin, Ltd., 1972), p. 224.

The system of open spaces was incorporated into the plan in order to interrupt the potential monotony of the gridiron street pattern, and to provide pleasure grounds and space for civic and religious centers. Thus, in its scale, its open squares, and its consistent use of wide streets intersecting at right angles Philadelphia represented something of an innovation in colonial town design.

To demonstrate the comprehensive manner in which Philadelphia was designed, Penn anticipated the need for property access for the rear of each lot. He instructed Holme to design the lots with sufficient depth so as to allow an alley way to be constructed at a later date.

> In the middle of the eighteenth century it became a common practice to build dwellings on the side lot lines resulting in continuous rows of buildings which cut off access to the rear yards. Alleys were then cut through the center of the blocks. These alleys have since become streets.[98]

Alley streets in today's older cities can be traced to William Penn's innovative thinking to plan for the critical problem of proper property access.

Penn's design of Philadelphia did not end at the riversides. Lands were also surveyed outside the city for the farm tracts. Penn promised the settlers

> . . . that the planning of a road system would receive early attention and no encroachments on public rights-of-way would be permitted. These roads, 40 feet wide, were to be planned before the land were to be divided for farming purposes, thus ensuring

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[98]Arthur B. Gallion and Simon Eisner, op. cit., p. 59.

that the best routes could be freely selected and would not be blocked by property owners unwilling to allow the road to cross their lands [see Figure 13].[99]

John W. Reps, in his book Town Planning in Frontier America, summarizes the impact of Philadelphia's gridiron street plan upon the American landscape.

> In particular, the Philadelphia city plan materially affected the subsequent course of town design in America. As the first large American city to be laid out on the gridiron pattern, Philadelphia has always been identified, usually unkindly, as the inspiration for the great era of rectangular town planning during the preceeding century. This influence is undeniable, but it was not always unfortunate. Even where the results proved unhappy, part of the blame must be assessed against those who disregard the good features of the gridiron or who extended an original settlement with mechanical regularity in disregard of topography.
>
> The original city of Philadelphia was built on comparatively flat land, and a regular street system was not illogical. Street widths were more than ample for the traffic of the time and were almost extravagant by European standards. Moreover, the plan at least provided for even wider major streets, a feature often overlooked by subsequent gridiron planners. . . .
>
> . . . . . .
>
> Penn and Holme . . . did not anticipate what might have been more obvious--the early development of the city north and south along the banks of the Delaware, outside the bounds of the original plan, instead of westward toward the Schuylkill. It was unfortunate that these later extensions did not incorporate the same sense of order in the street sytem or provide the same proportion of open spaces as did the planners of what is still the original portion of that great city.
>
> For many of the towns that sprang up later during the westward march of urbanization, Philadelphia served as the model. The regular pattern of streets and one or more public squares were features that became widely imitated. Throughout Pennsylvania there are dozens of towns, large and small, that incorporate these elements in their plans. Reading, Allentown, Lancaster, York, and Pittsburgh were laid out with open spaces or rectangles having four streets intersect the middle of the square's sides. In Lancaster County alone at least six communities use the Philadelphia square as the central motif.

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[99] John W. Reps, op. cit., pp. 147, 149.



Figure 13. Philadelphia Hinterlands.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 148.

> This pattern of grid and public square appears throughout the south, and midwest and beyond, copied from Philadelphia or from another imitation. In at least two state capitals, Raleigh, planned in 1792, and Tallahassee, surveyed in 1824, the identical distribution of five open squares to be found, and a half-dozen or so smaller and less important cities also imitated this plan. . . .
>
> . . . . . .
>
> However inadequate the public square of the midwestern towns may be as a symbol of civic consciousness or a focus of architectural attention, it at least supplies a break in the almost intolerable rhythm of a relentless grid.[100]

The most impressive example of city planning and gridiron street design after Philadelphia came with the establishment of Savannah, Georgia. Early in the eighteenth century, a well-to-do Englishman named James Oglethorpe and some associates got a charter from the King of England to found the colony of Georgia. Oglethorpe's mission was to layout and build a new capital city. His choice for a site was located high on the banks of the Savannah River (see Figures 14 and 15).

> Few American cities used the gridiron as more than an equitable expedient: Savannah is probably the most important exception and the orthogonal geometry of the urban mid-west well might have been less monotonously debasing under its influence. . . . Savannah was different because it was laid out on the basis of future cellular units and not as an infinitely extensible grid. The units, called wards, contained 40 house plots and had an identical layout: four groups each of ten house plots and four house plots reserved for public buildings enclosed a public square. . . . The route structure which organised the cells into an urban entity clearly differentiated between types of traffic on a hierarchical basis. Main streets were 75 feet wide, minor streets half that width, and the back access service lanes (reminiscent again of bastide planning) were 22-1/2 feet wide. . . . Tree-lined boulevards parallel to the river, replacing ordinary streets at intervals, and the creation of an axis at

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[100] Ibid., pp. 152-154.

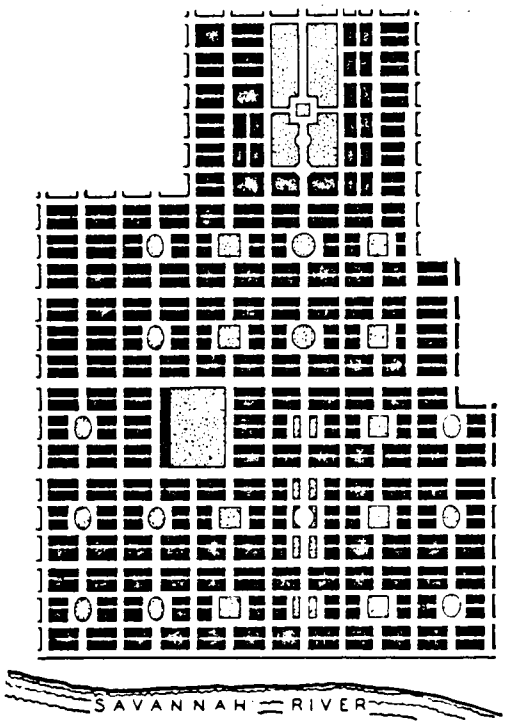


Figure 14. Savannah, Georgia.

Source: Arthur B. Gallion and Simon Eisner, The Urban Pattern, City Planning and Design (New York, New York: D. Van Nostrand Company, 1975), p. 59.

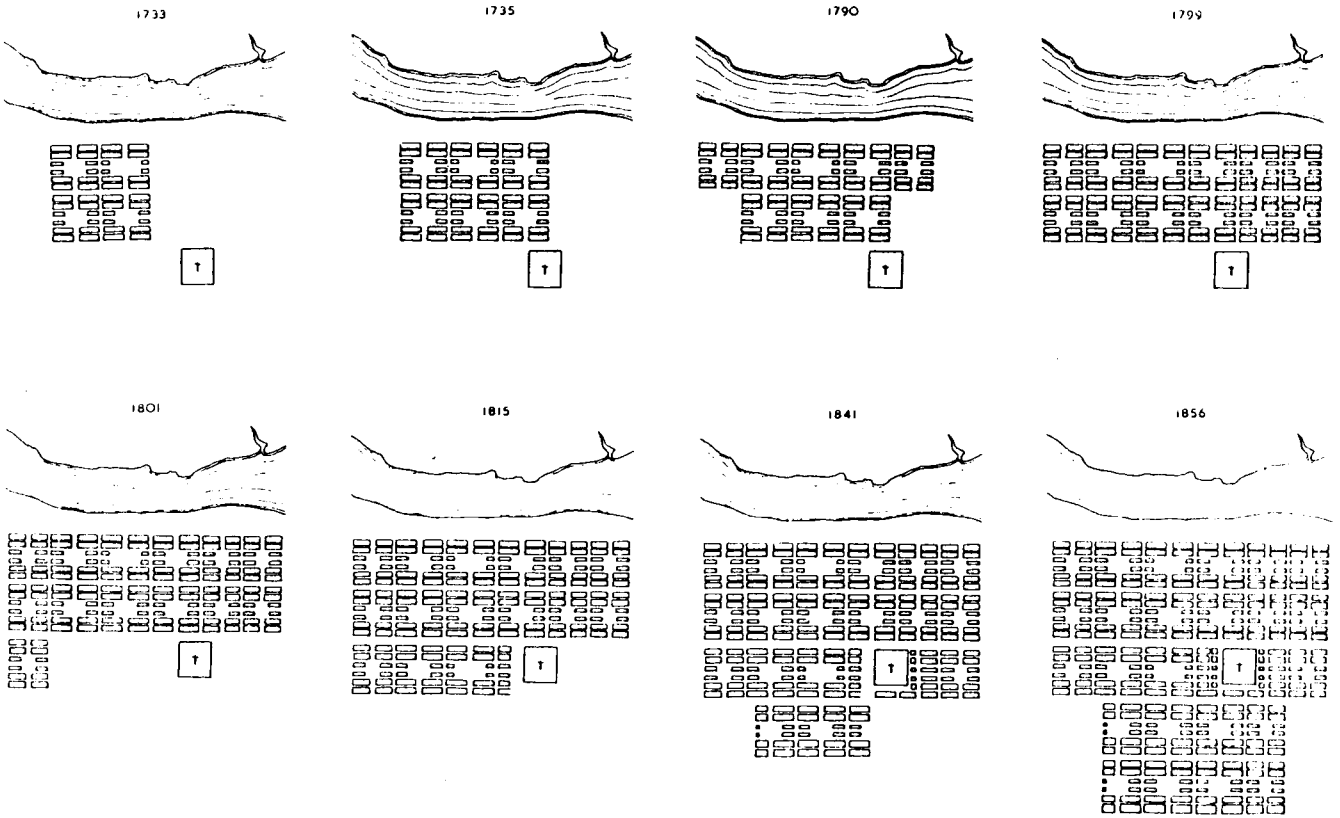


Figure 15. The Growth of Savannah: 1733-1856.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 177.

> right-angles, through the centres of five wards and continued by a large late nineteenth century park, ensured that Savannah's unique growth by cellular repetition did not lose coherence with size.[101]

Edmund Bacon praised the innovation and foresight of James Oglethorpe in designing and laying out the street plan for Savannah. Mr. Bacon stated that:

> The Savannah planners have been wise enough to use wide tree-lined boulevards in place of the ordinary streets at intervals, marking stages of growth parallel to the river. This gives a sense of large-scale orientation to the street network, and an added rhythm to progression away from the river.[102]

Non-Gridiron Cities in American Colonization

Colonial town planning in America generally adopted the gridiron street pattern because of the ease in which land could be surveyed, platted, and developed. However, despite the gridiron's utility and popularity, many New England cities' street patterns were designed using the European baroque and medieval concepts. Often, the application of a gridiron upon the landscape was not practical and it became necessary to use a different pattern for street design and layout. Imagination and innovation guided the design of many non-gridiron street patterns for cities along the eastern seaboard.

> Whereas the New England pattern is best defined as controlled organic growth--with the planned field and street layouts determined by natural, topographical boundaries--by 1786 in the midwest the inflexible surveyors' gridiron, which essentially ignored

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[101] A.E.J. Morris, op. cit., pp. 229-230.

[102] Edmund N. Bacon, op. cit., p. 221.

> topography, had no longer been accepted as the only practical method of controlling the growth of the nation. New England therefore contains almost all of the USA's historic non-grid urban cores, notably Boston and, further south, New York.[103]

The Dutch settlement of New Amsterdam, later renamed New York, began as a star-shaped fortress located on the southern tip of Manhattan Island. The town proper was to be located within the walls of the fortress in which a rectangular pattern of roads and ditches was to be laid out for the first farmers.

> This neat symmetrical pattern conceived in the security and comfort of the company's offices in Amsterdam proved unsuitable to the site on the tip of Manhattan and was beyond the resources of the colonists to carry out. It was soon abandoned, and the town developed with little in the way of an overall plan for its growth. New streets were laid out from time to time as they were needed, usually following the lanes that had becomes established naturally as men and animals followed the most convenient paths between houses, farms, and the fort. This method of growth resulted in streets of irregular alignment and width. As the population increased and land near the fort became more valuable, encroachments on the streets added to the lack of order [see Figure 16].[104]

The new Dutch city originally had a large protective wall marking the northern limit of the city. A street running parallel to the wall from the East River to Broadway was built to serve the wall and provide access in protecting the residents from attacks from the Indians and the British. This was and still is Wall Street, probably the most famous street in the United States today.

Dutch rule of New Amsterdam came to an end in 1664. The

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[103] A.E.J. Morris, op. cit., pp. 218-219.

[104] John W. Reps, op. cit., p. 128.

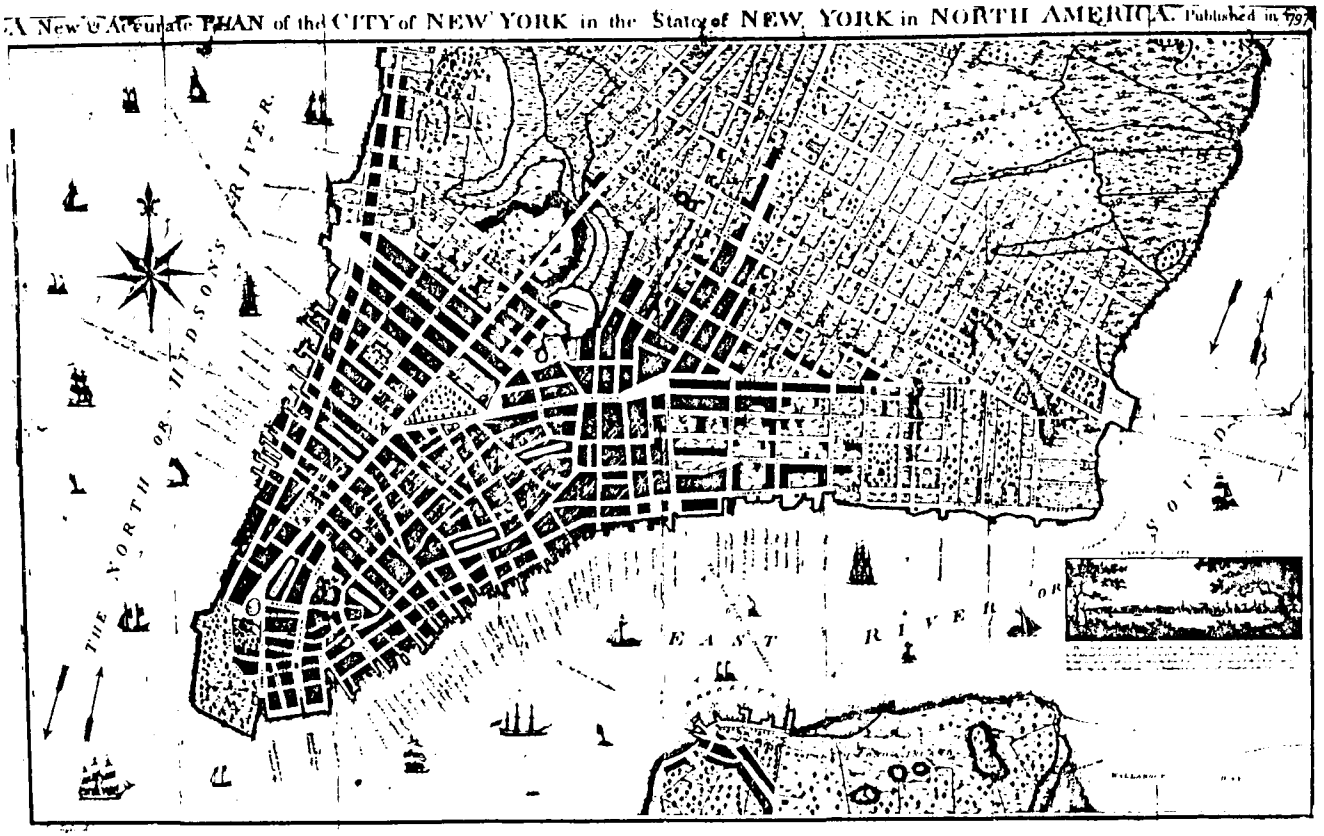


Figure 16. New York City, New York.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 136.

English renamed the city New York and soon thereafter new growth took place. By 1700, new streets and building sites were being surveyed north of the old city wall. Expansion took place without the benefit of a systematic growth plan. Instead, street by street, lot by lot, relatively small parcels of land were surveyed and sold by the owners of farms adjoining the city in any way they pleased.[105]

Toward the middle of the eighteenth century increased need for developed land resulted in the subdivision of several large tracts north of Wall Street. Francis Maerschalck, the city surveyor, platted land along the Hudson River in a rectangular configuration. A few years later, Casmir Goerck, became the city's new surveyor. In recognition of New York's desire to advance commerce in the area, Goerck surveyed and platted the remainder of Manhattan Island which had come into municipal ownership back in 1686. Goerck first laid out these lands in 1785 in large rectangular parcels, following the pattern of Francis Maerschalck. In 1797, he platted several north-south streets each 100 feet wide with cross streets running east and west each 60 feet in width.[106] This began a series of events that culminated in a gridiron street plan for most of the Island of Manhattan (see Figure 17).

> In 1804 the mayor and aldermen of New York decided to survey all existing street and building lines on the city. . . . In an effort to detach this important task from the frictions of local politics and the conflicting claims of property owners, the city

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[105] Ibid., p. 132.

[106] Ibid., p. 135.

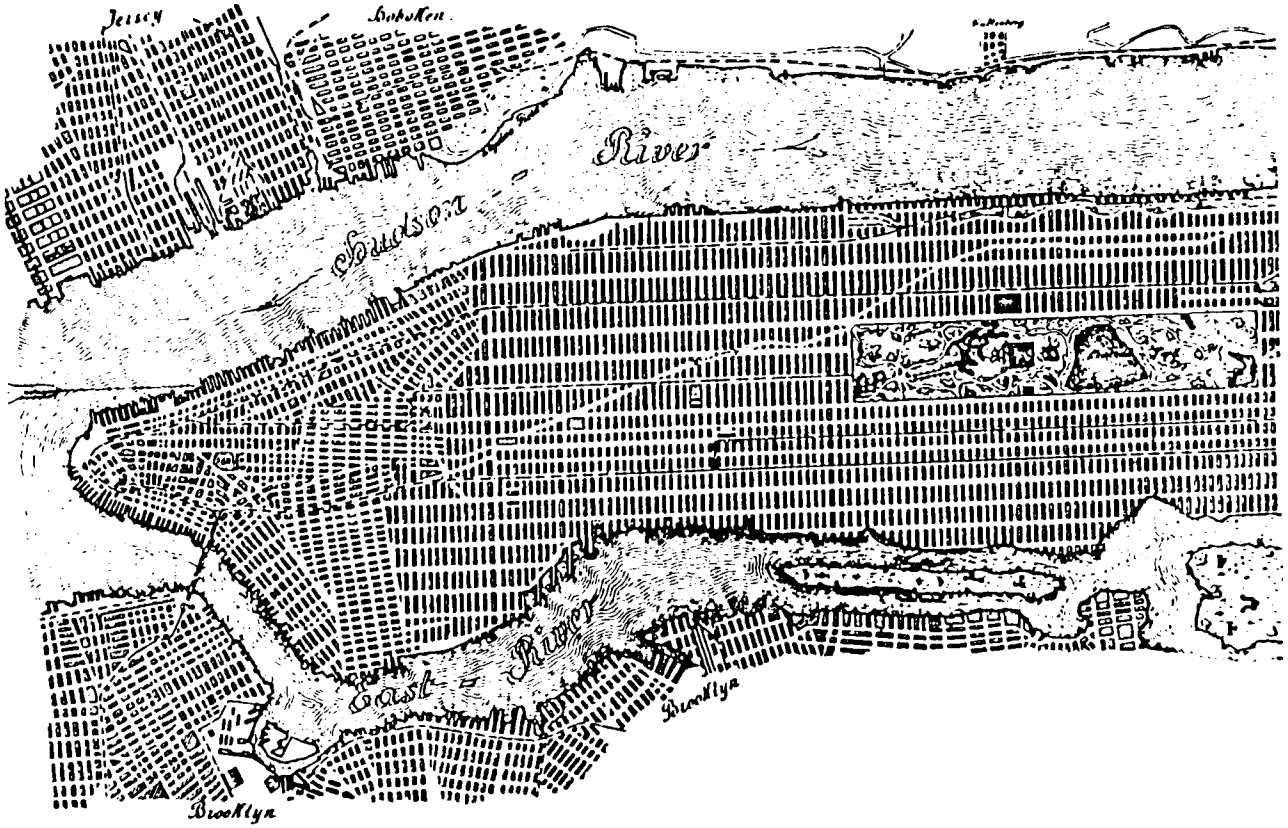


Figure 17. New York City in 1797.

Source: A.E.J. Morris, History of Urban Form, Prehistory to the Renaissance (London, England: George Godwin, Ltd., 1972), p. 227.

requested the state legislature to appoint a commission for this undertaking.[107]

The commission was set up. They found it difficult to adjust their plan to the irregular property boundaries and the random streets that already existed in the vast territory under their jurisdiction. The commission decided to use a mechanical and rigid grid in an attempt to straighten out the mess. In making their decision they debated as to:

> . . . whether they should confine themselves to rectilinear and rectangular streets, or whether they should adopt some of those supposed improvements, by circles, ovals, and stars, which certainly embellish a plan, whatever may be their effects as to convenience and utility. In considering that subject, they could not but bear in mind that a city is to be composed principally of the habitations of men, and that strait sided and right angled houses are the most cheap to build, and the most convenient to live in.[108]

The gridiron street plan created and implemented by the appointed commission in 1811 was identical to the survey and plat designed by Goerck some fourteen years earlier. The difference being the commission was granted powers to oversee the implementation of the gridiron street system. The street plan for New York was considered very farsighted for its day, much in excess of what anyone believed would be needed even in the distant future.

Despite the generous amounts of land that were dedicated for the street system, the plan contained some major flaws. Most notably

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[107] Ibid.

[108] Ibid., p. 137.

was the application of the gridiron street system upon a terrain which was characterized by sharp changes in elevation on the island. The street system the commission established is totally unrelated to the contours of the land. Along with the general mechanical dullness produced by their gridiron pattern, the commission ignored important existing roads. "One or two of these, notably Broadway, did manage to survive the rigid grip as development took place, but the others gave way under the subsequent relentless expansion."[109]

> The unfortunate results of the prejudices and mistakes of the planners of 1811 are well known today. . . the traffic congestion at the frequent intersections, the absence of enough north-south arteries . . . these are but a few of the shortcomings. Even by the standards of the early 19th century the plan was inadequate. . . .
>
> . . . . . .
>
> True enough, no one could have foreseen the rapid growth of the city and the changes in transportation that lessened the importance of the river-to-river cross streets while placing an increased load on the less numerous north-south avenues. But one cannot avoid the conclusion that the commissioners, in fixing upon their plan, were motivated mainly by narrow considerations of economic gain. Their surveyor, Randel, was later to defend the plan by steadfastly maintaining its utility for the "buying, selling and improving of real estate." As an aid to speculation the commissioners plan was perhaps unequaled. . . . The fact that it was this gridiron New York that served as a model for later cities was a disaster whose consequences have barely been mitigated by more recent city planners.[110]

Boston, Massachusetts, is a classic example of a city which developed a non-gridiron street pattern sensitive to the topographical constraints of the area. Unlike New York, in Boston "the first

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[109] Ibid., p. 139.

[110] Ibid., pp. 139-140.

proprietors took pains to follow the local topography when they sketched their plan, and then stuck to it" (see Figure 18).[111] While the organic street pattern was adequately designed for the slow movements of pedestrians and horse carriages of the seventeenth century, Boston's current transportation requirements have made many of these streets antiquated. John W. Reps, in discussing Boston's historical development observed "that these minor topographical variations shaped the early street patterns that have so persistently remained to plague the modern driver,"[112] is a clear indication of the traffic problems many cities have inherited from generation to generation. Portions of Boston did develop in a gridiron configuration in a fairly early attempt to break away from the rambling alignment of the city's streets elsewhere, however, these were rare and often unsuccessful ventures.

Annapolis, Maryland, had probably the most novel street plan in colonial America. "With its two great circles, the imposing Bloomsbury Square, and the several radiating diagonal streets, the layout introduced a new concept of civic design to colonial America."[113] Annapolis was designed by Francis Nicholson who was inspired by the monumental effects of baroque design in France. Following accepted planning practice standards of this style, Nicholson set aside the highest and most commanding sites for the

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[111]Charles N. Glaab and A. Theodore Brown, op. cit., p. 6.

[112]John W. Reps, op. cit., p. 119.

[113]Ibid., p. 92.

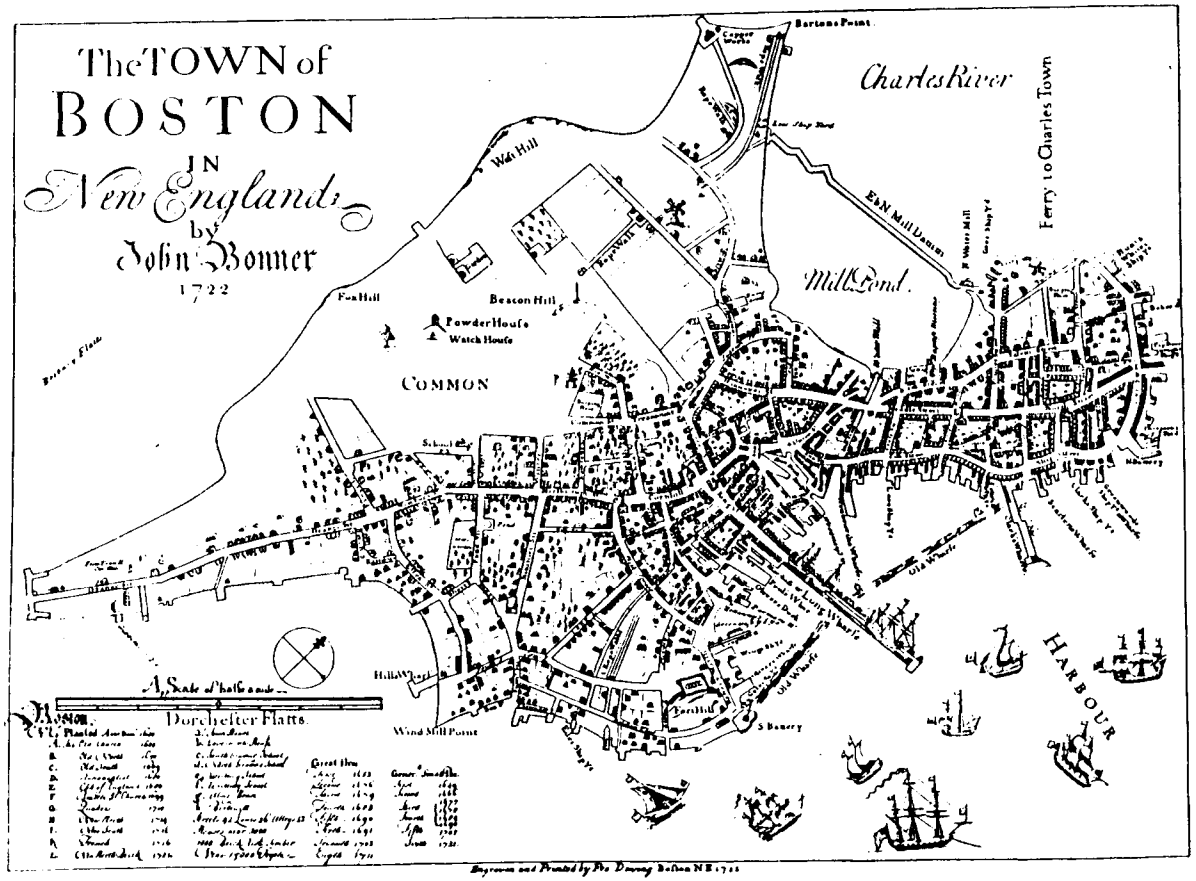


Figure 18. Boston, Massachusetts.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 121.

statehouse and church. These prominent buildings were located within each of the great circles and were the focal points of the radial streets (see Figure 19).

> One curious detail appears in the diagonal streets. Those leading into the statehouse circle have a pinwheel alignment; not one is directly on axis with the center of the circle. It is hard to believe that this was anything but deliberate, but the motives are unclear. It may well have been a case of Nicholson's lack of comprehension of one of the aims of the Baroque design--that is, to create as many terminal vistas as possible by ending diagonal streets at some great public building or monument. The many lots bisected by the diagonal streets and the unfamiliarity of the planner with some of the problems inherent in this type of layout.[114]

New York, Boston and Annapolis represent a diverse cross-section of the non-gridiron street plans found in colonial America. While each of the three cities were designed with a different street pattern ideology, all of the cities shared a common element: each city was designed and developed adjacent to an ocean bay or river. Water frontage was very important for the economic success and vitality of a city. Hundreds of other smaller colonial communities were also built along the shores of the Atlantic and interior water-ways of the new land. These smaller communities often designed and built roads and streets parallel to the desired water frontage. Salem, Massachusetts, was a typical example of a small community which developed a "linear" street system, where a single street forms the spine of the settlement, adjacent to water (see Figure 20).

A discussion of street planning and design in colonial America

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[114]Ibid., p. 94.

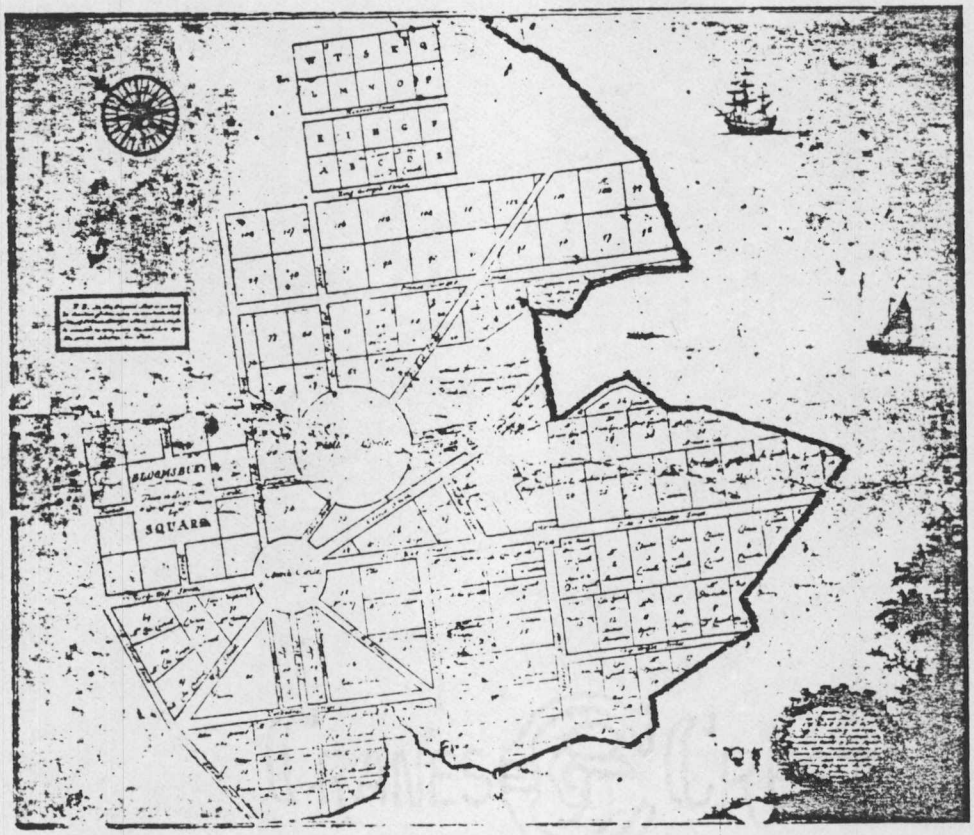


Figure 19. Annapolis, Maryland.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 93.

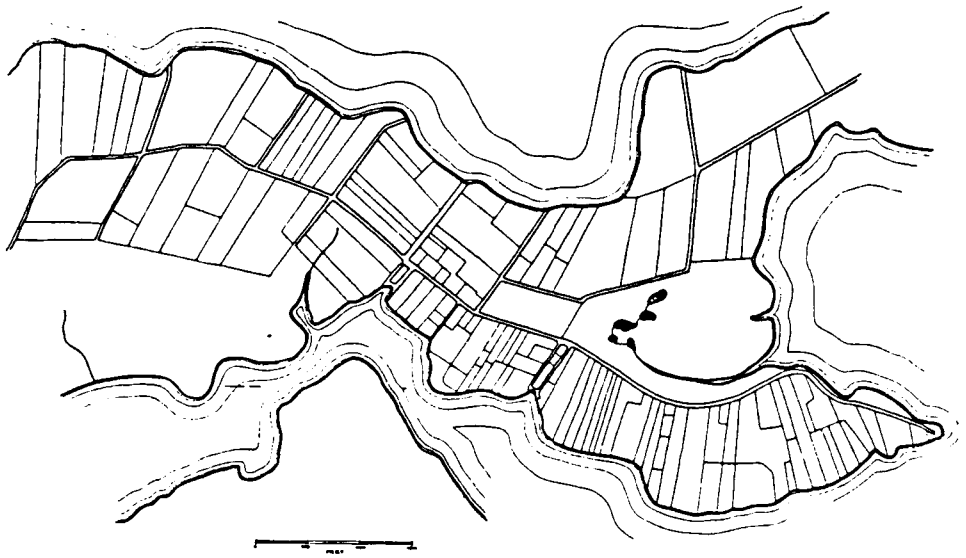


Figure 20. Salem, Massachusetts.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 107.

would not be complete without recognition of Washington, D.C. Washington, D.C. was designed to combine the best street design features of the classic Renaissance cities of Europe with the traditional gridiron street pattern. The successful integration of these two contrasting street design philosophies made Washington, D.C. the premier planned city in the United States. Its highly unusual plan introduced to America new concepts of city design.

The planning and design of Washington, D.C. began as a legislative act of Congress. President George Washington was authorized by the Residence Act of 1790 to select a site, not more than ten miles square, along the Potomac River. Possible sites were investigated during the autumn of 1790, and in January 1791 the President announced his choice. President Washington selected a site near the small town of Georgetown as the home of the new capital.

To secure an accurate survey of the new district, President Washington appointed Andrew Ellicott, a professional surveyor, to run the bounds of the area and to report on its major topographical features. A month later Washington appointed Major Pierre Charles L'Enfant to prepare drawings of sites which might be appropriate for public buildings.

L'Enfant, an architect and military engineer from Paris, France, completed his site planning tasks well. For example, he identified Jenkins Hill as the most appropriate location for the new capitol building (it is still the site of the capitol building today). Washington rewarded L'Enfant's fine efforts by commissioning him to plan the entire city.

L'Enfant began not with the street system, but with the principal buildings and squares.

> Between these cardinal points he devised "Lines of Avenues of direct communication," aimed not merely to promote traffic but to "preserve through the whole a reciprocity of sight at the same time," with special attention to convenience and pleasant prospects en route.[115]

"L'Enfant stressed 'magnificent distances': broad avenues radiating from central squares, leaving great empty spaces which could only be filled in as the city grew up to his plan."[116]

The L'Enfant plan "provided for a combination of diagonal and radial streets, which were superimposed upon a traditional gridiron. This grand plan clearly showed the influence of French civil design" (see Figure 21).[117] L'Enfant's understanding of the plan's complexities came at an early age when he was raised in the city of Versailles, France. L'Enfant spent much of his childhood in and around the palace and park of Versailles. The streets leading up to the palace and park were a combination of gridiron and superimposed diagonal streets.[118] "He was also a student in Paris where he would have appreciated the carefully arranged 'use of monuments or important buildings as terminal vistas to close street views.'"[119]

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[115]Lewis Mumford, op. cit., p. 404.

[116]Charles N. Glaab and A. Theodore Brown, op. cit., p. 43.

[117]William I. Goodman and Eric C. Freund, eds., op. cit., p. 11.

[118]A.E.J. Morris, op. cit., p. 234.

[119]Ibid.

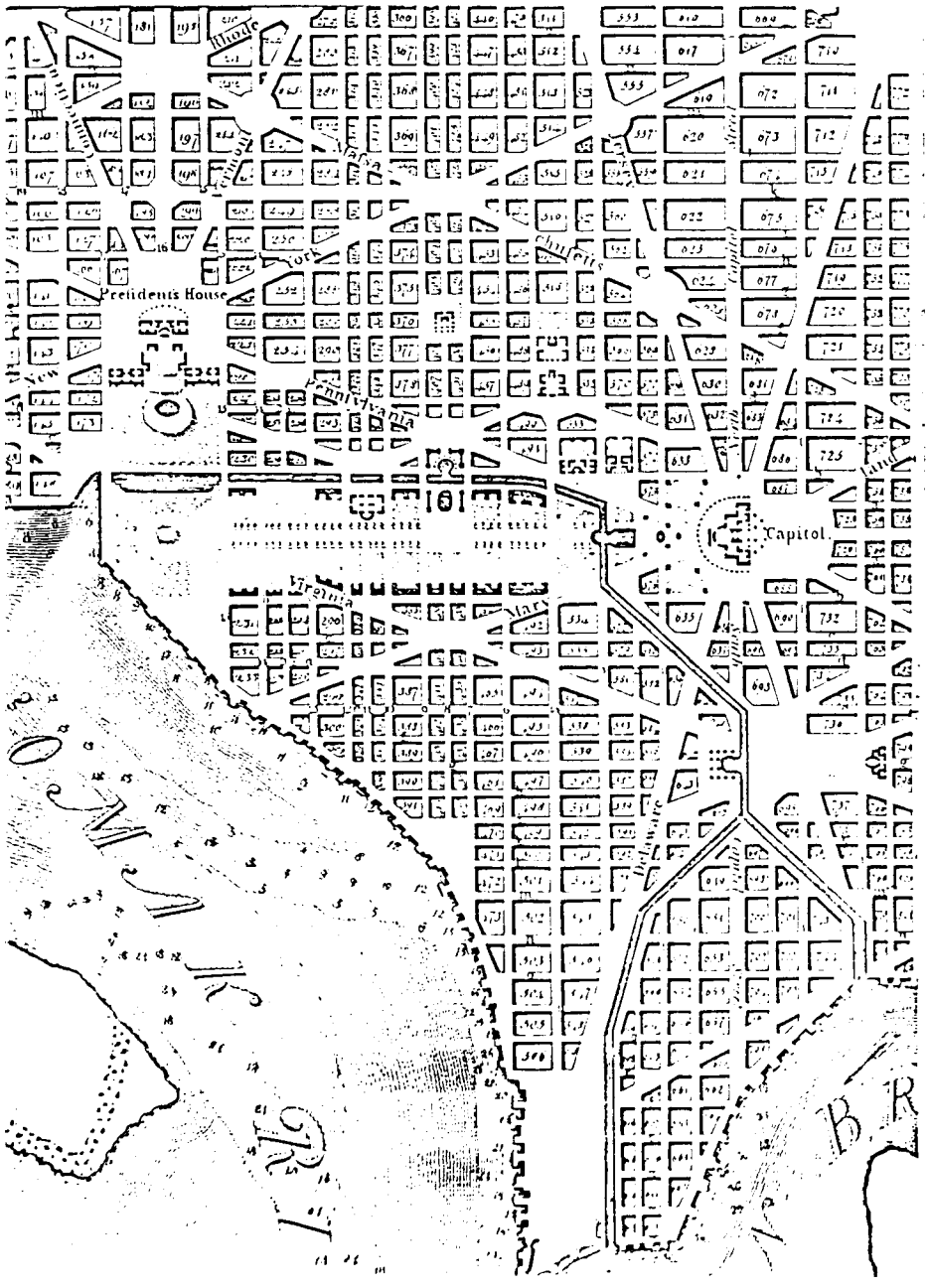


Figure 21. Washington, D.C.

Source: Edmund N. Bacon, Design of Cities (New York, New York: Penguin Books, 1974), p. 176.

Mr. A.E.J. Morris, in his book History of Urban Form, commented on L'Enfant's distinctive plan for Washington, D.C.:

> The apparent complexity of the layout was developed from a simple base: that of the right-angled triangle formed by the Capitol, the President's House and at the intersection of their respective east-west and north-south axes, the Washington Memorial. These axes were also those of a regular gridiron--the essential basis of a land sub-division. The third side of the triangle cut across the grid as a direct link between the Capitol and President's House. This is Pennsylvania Avenue, ostensibly the nation's most important street, and it symbolises the distinct but mutual relationship between legislature and executive. Based on the diagonal line of Pennsylvania Avenue, a system of symmetrically arranged main routes was superimposed on the grid to connect other key internal locations and to relate to important regional roads.[120]

Lewis Mumford made this observation about the new capital's street plan:

> Washington was planned as a series of interwoven traffic spider webs, with its main avenues as generous in their dimensions as the Champs Elysees. The principal avenues were 160 feet wide, with 10 feet of pavement on each side, 30 feet of gravel walk "planted with trees on each side," and 80 feet in the middle of the carriage way. Even the lesser avenues, like those leading to public buildings or markets, were 130 feet wide, while the remaining streets, 110 to 90 feet, vie with the largest crosstown streets provided for in the 1911 plan for Manhattan, and surpass in generosity anything considered elsewhere in historic cities.[121]

Mr. Mumford continued his critique of L'Enfant's grandiose street plan for Washington by calculating:

> Of the sixty-thousand-odd acres included in his plan, 3606 were required for highways, while the land required for public

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[120] Ibid., pp. 236-237.

[121] Lewis Mumford, loc. cit.

> buildings, for grounds or reservations, was only 541 acres. By any criterion that apportionment between dynamic and static space, between vehicles and buildings, was absurd. Only a modern highway engineer, with extravagant intersections, could compete with L'Enfant in the reckless wastage of precious urban land. . . .
> . . . . . .
> The street system demanded a city of at least half a million people to justify it; the plan permitted, on its own original terms, something on the order of a hundred thousand.[122]

The ambitious over-planning of Washington's street system was not a mere abstract design conceived in ignorance or disregard for the natural conditions of the site. L'Enfant wanted to create a capital city that expressed the glory and power that the new nation would surely attain. Broad avenues and sweeping vistas would enhance this image and thus be the basis for his plan.

This great essay in urban planning was not without its faults, however. Inherent in the combination of two contrasting systems of streets--the underlying gridiron and the bold pattern of radials--was the creation of dozens of awkward intersections and strangely shaped building sites. These problems plagued land speculators and promoters in selling parcels of land in Washington for a number of years. For the first few decades of the city's existence most of these lots laid idle and vacant. Many of these unbuildable sites were later utilized for small parks or sites for monuments.[123]

L'Enfant's street plan for Washington, D.C. had all the aspects of a superb baroque plan: grand avenues, the axial approaches, and

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[122]Ibid., pp. 404-405.

[123]John W. Reps, op. cit., p. 224.

the siting of important public buildings. He first located the major funtions and buildings and then provided direct connections through the system of diagonal boulevards. He was ahead of his time in attempting differentiation in street design on the basis of functional requirements in a desire to separate purely local and service traffic on the grid streets from long journeys via the major connecting radials.

Unfortunately much of the original L'Enfant plan was not implemented as specified by L'Enfant himself. Government parsimony, the momentum of real estate development, and the ideas of urban designers eroded detail after detail of his original plan. Andrew Ellicott was later asked to design a new street plan for Washington, D.C. Partial recapture of L'Enfant's grand designs were accomplished through the McMillan Commission's work in 1901, a full century later. The basic elements of the original street plan are still intact, however, they have been modified somewhat by the changes and needs of the automobile.

Northwest Land Ordinance of 1785

> After the Revolutionary War and the adoption of the federal Constitution the great part of the land of the United States outside the orignal thirteen colonies became the property of the federal government, either as a result of cession by the original thirteen states or by trades, purchase, or treaty.
>
> The federal government found itself with vast tracts of underdeveloped and uninhabited land that had few natural characteristics suitable for use as monuments in metes-and-bounds description.[124]

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[124]Joseph DeChiara and Lee Koppelman, Site Planning Standards (New York, New York: McGraw-Hill Book Company, 1978), p. 7.

By the end of the eighteenth century colonists began to migrate westward in large numbers. A method of surveying and platting this new frontier land was needed. The Northwest Land Ordinance of 1785 represented the results of a compromise between the government's desire to raise public funds from the sale of land and mounting pressure from the countless thousands who wanted enough land, preferably as a land grant, for a farm.[125]

> The law required that the territory to be sold should be laid in rectangular townships, 6 miles square. Each township was to be divided into 36 square sections of 1 square mile or 640 acres. Half the land was to be sold to townships, the other half by sections. The rectilinear survey basis obviously disregarded topography, with many anomalous results, but it was easy to locate a purchase in the wilderness and to avoid boundary disputes. . . .
> . . . . . .
> Given the speed of western expansion, there was no alternative to general adoption of these regional grids, and their existence as property boundaries reinforced the preference for gridiron urban structuring. Section boundaries proved natural rural road lines and villages either established themselves at junctions, or were laid out and promoted by property speculators [see Figure 22].[126]

With the implementation of the Northwest Land Ordinance of 1785, cities in the midwest began to spring up quickly. Much of the initial western expansion occurred along the shores of the Great Lakes and the Ohio River Valley. Particularly evident are the numerous small agricultural townships which developed in these areas. Many of these towns were laid out at the junction boundaries. Often the main roads in town were located on these boundaries. In many areas of the

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[125] A.E.J. Morris, op. cit., p. 220.

[126] Ibid.

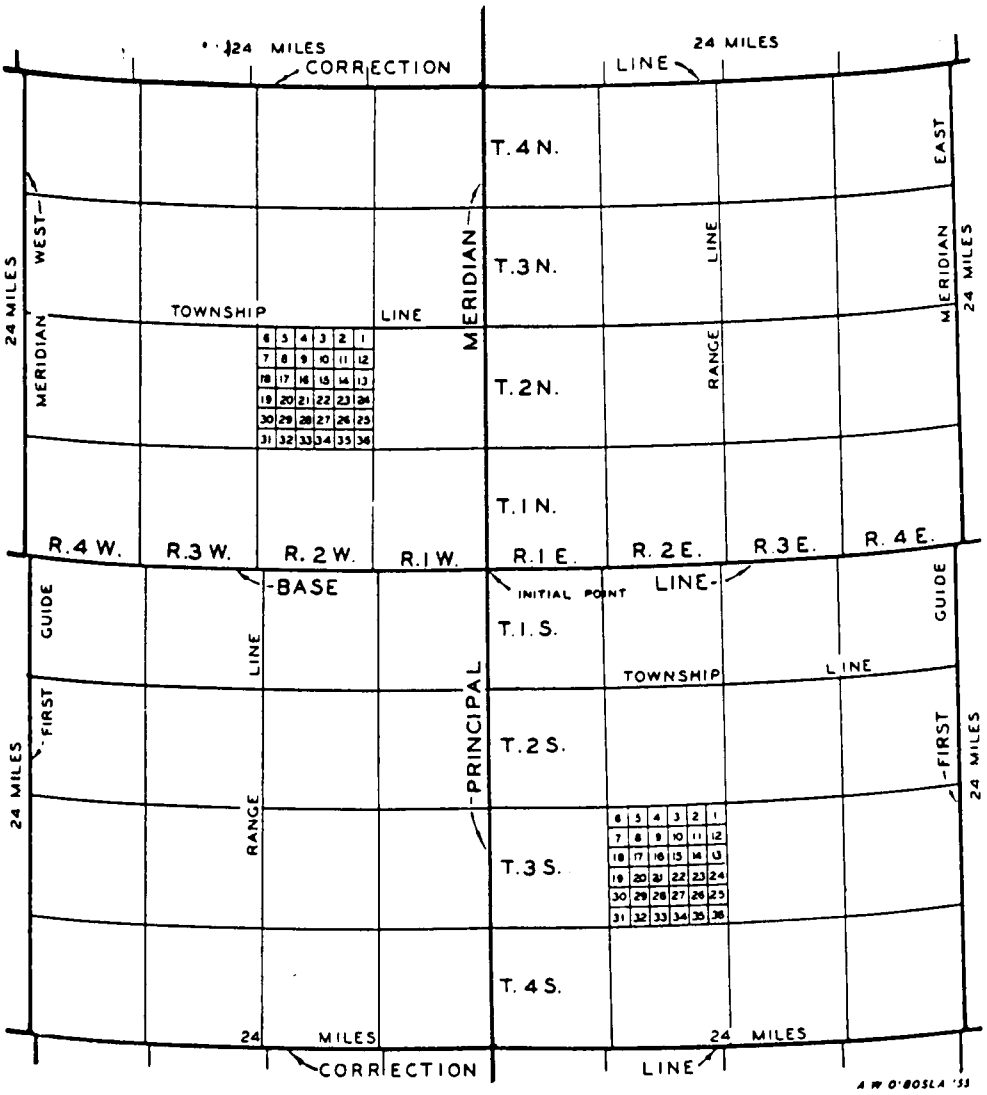


Figure 22. Northwest Land Ordinance of 1785 Meridians and Base Lines.

Source: Joseph DeChiara and Lee Koppelman, Site Planning Standards (New York, New York: McGraw-Hill Book Company, 1978), p. 9.

midwest farm roads were aligned in large grids of one mile each to coincide with the junciton boundaries. An interesting variety of city street plans were also developed and planned for these vast tracts of surveyed land.

Under the guidance of the Northwest Land Ordinance of 1785, cities typically laid out street systems in basic gridiron patterns. These gridiron street patterns often followed the boundaries of the subdivided land, in squares or rectangles of 640 acres, 320 acres, 160 acres, 80 acres, 40 acres, 20 acres, 10 acres, and 5 acres. This form of land subdivision has been identified as an "English" style of land subdivision because of its wide-spread use in England for hundreds of years.

In the areas that were under French control the principles of land subdivision set forth in the Northwest Land Ordinance of 1785 were not used. The "French" style of land subdivision featured tracts of land (usually eighty acres) that were very long and extremely narrow. These lots were planned for agricultural purposes originally and were not platted to accommodate urban needs. The configuration of these parcels discouraged encroaching urban development and affected the design and layout of the street systems in and around these tracts of land. There were typically few cross-streets built and the roads which penetrated these lots were developed as long cul-de-sacs or dead-end streets.

City Street Design in the Midwest

City street design and layout in the Midwest was by in-large a product of land promotion and speculation. With the aid of the Northwest Land Ordinance of 1785, hundreds of new cities and towns were planned. A variety of distinctive gridiron street plans were created to attract new settlers to these new cities. Most of these cities were nothing more than paper speculations. Sometimes they were designed simply to defraud the unwary--lots or acreage being sold where there had been no survey done at all. Below is a review of some of the more interesting street plans that were devised during the great westward expansion.

Basic to the design and promotion of cities of the midwest was the utilization of the traditional gridiron street pattern. "The general acceptance of the gridiron design in laying out cities facilitated the conception of property rights by making property transactions simple and convenient."[127] Town planners and promoters also liked the great advantages of the gridiron because of the ease of layout and surveying, the ease of obtaining a legal description, and the ease of merchandising the subdivided properties. The gridiron street plan was also viewed as a means for facilitating the buying, selling and improving of real estate. Little regard was given to the topography, and the reservation of open spaces was rarely considered. Franklinville and Lystra, Kentucky, were the forerunners of hundreds of similar speculative gridiron enterprises (see Figure 23). The

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[127]Charles N. Glaab and A. Theodore Brown, op. cit., p. 230.

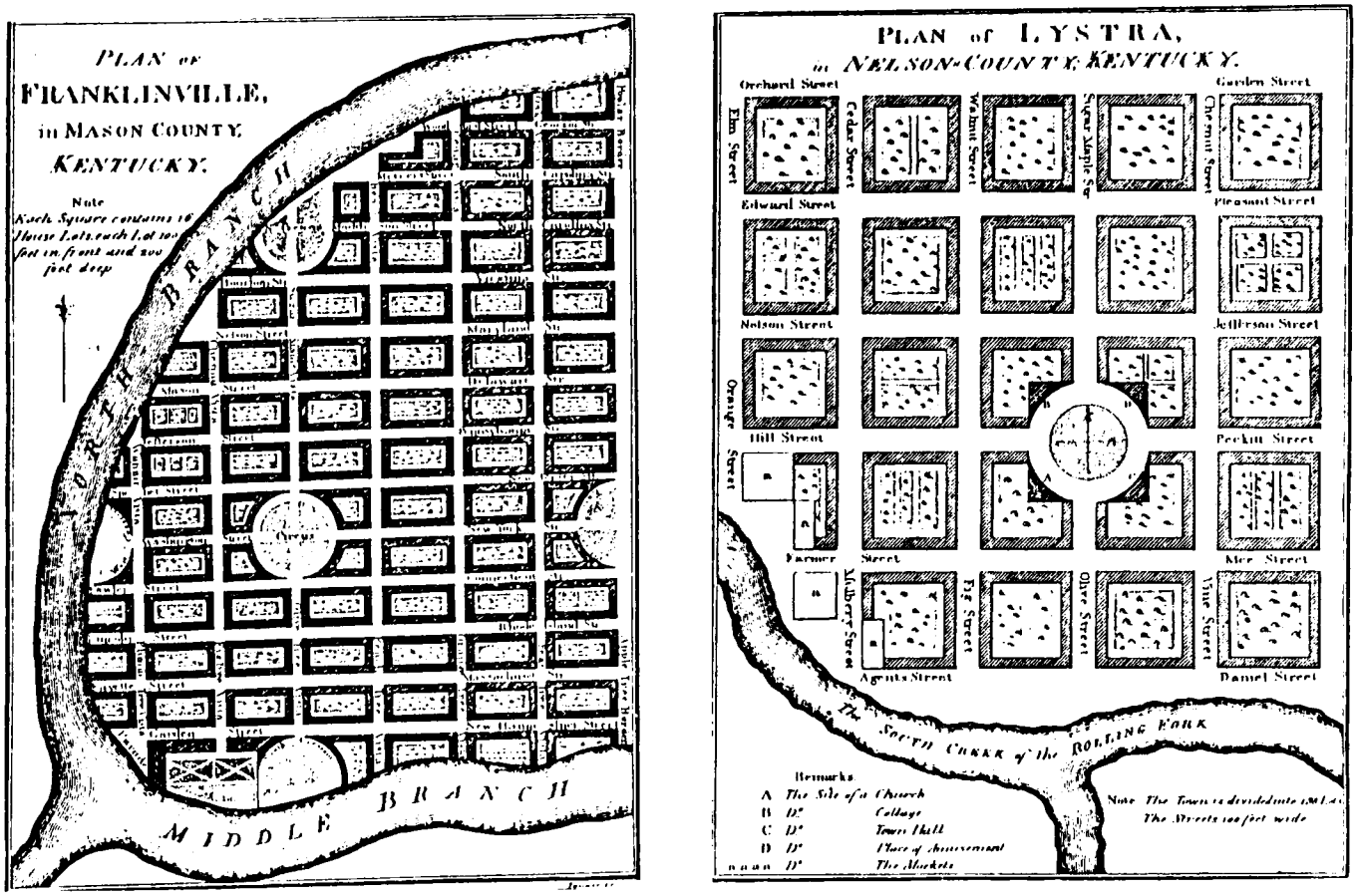


Figure 23. Franklinville and Lystra, Kentucky.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 188.

unusual and distinctive feature of these cities was the circular park, sometimes located in a central point or at the end of the city's main north-south, east-west streets.

Hygeia, Kentucky, was another of the speculative paper towns that failed to live up to the inflated claims of their sponsors. The town's street pattern appears more as an abstract design than a functional system (see Figure 24). "The four diagonals lead from the outer corners of the small squares to nowhere, and, with no real focus of architectural interest at either end, these streets are largely meaningless."[128]

Jeffersonville, Indiana, was another city of unusual design. President Thomas Jefferson, who had been closely involved in the planning and design of Washington, D.C., and who had been concerned with the drafting of the Northwest Land Ordinance of 1785, authored the creative plan for Jeffersonville (see Figure 25). The distinctive feature of the plan was the alternating pattern of open squares and subdivided blocks. "Jefferson had conceived this system of urban development as a measure to prevent yellow fever, a disease then plaguing American cities."[129] President Jefferson described his plan and its advantages:

> Take, for instance, the chequerboard for a plan. Let the black squares only be building squares, and the white ones be left open, in turf and trees. Every square of houses will be

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[128]John W. Reps, op. cit., p. 191.

[129]Ibid., p. 194.

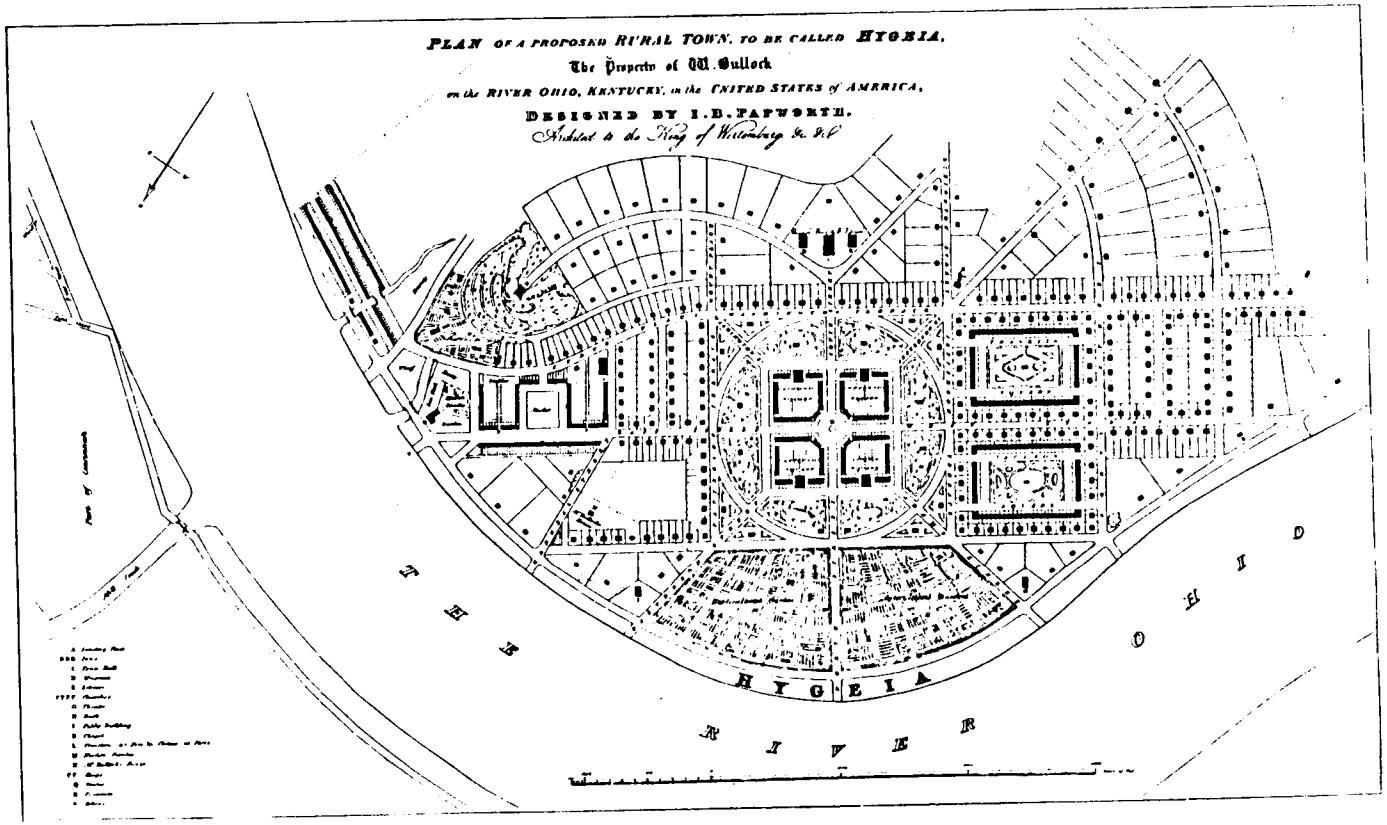


Figure 24. Hygeia, Kentucky.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 190.

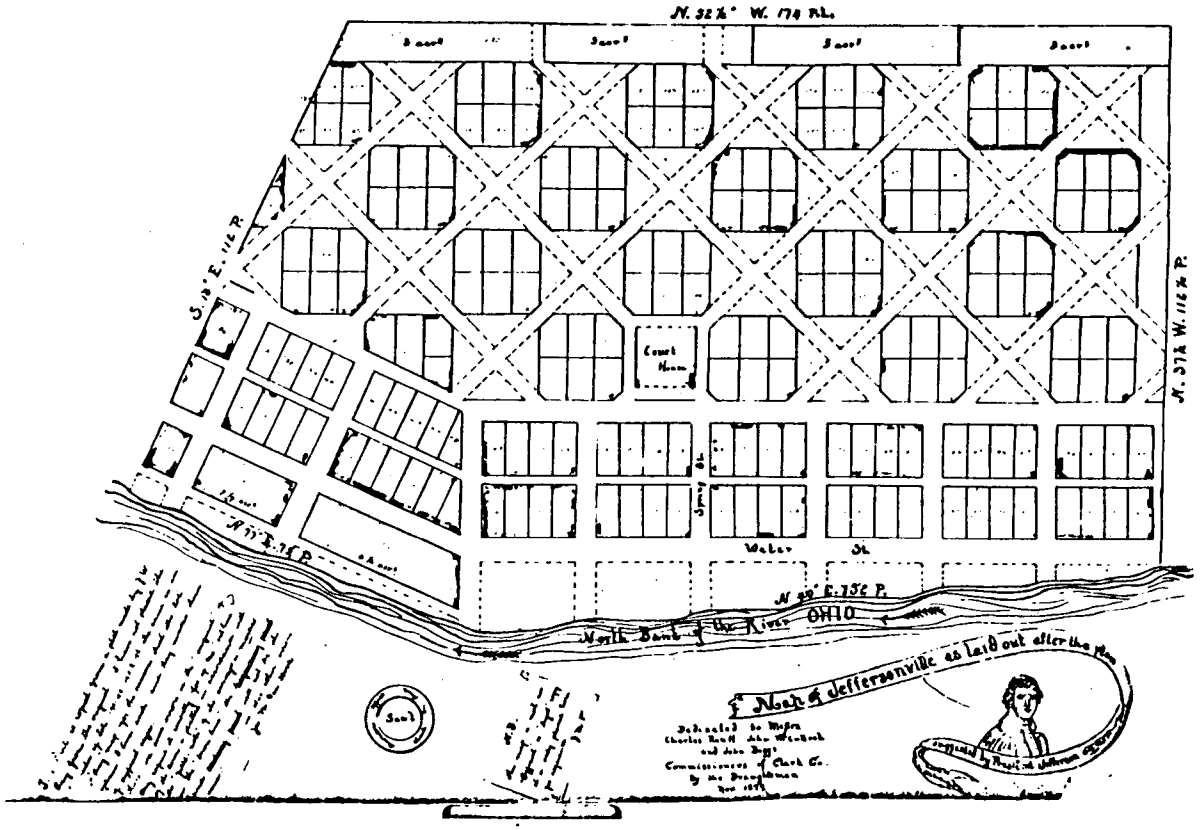


Figure 25. Jeffersonville, Indiana.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 195.

rounded by four open squares, and every house will front an open square.[130]

In one respect the plan of Jeffersonville departed from the ideas established by President Jefferson.

> Diagonal streets were introduced cutting through the open squares so that the gridiron street system ran at an angle of forty-five degrees to the checkerboard axis of the city blocks. Perhaps John Gwathmey, the executive planner who laid out the town, wished to employ the most up-to-date features of civic design, presumably as then embodied in the radial plan for Washington. Even with the streets destroying much of the open space the plan of Jeffersonville was a remarkable achievement in town design.[131]

The town's proprietors opposed the plan with its wasteful use of space. The proprietors petitioned Congress to obtain legislation allowing them to replat the town into a conventional grid pattern. The final plan contained only one of the original open squares and is "perhaps the first example of urban redevelopment in America."[132]

Marietta, Ohio, was designed by Rufus Putnam in 1788. He faced the unusual constraint of designing a street plan atop a spot which had previously been occupied by early mound-building Indians. Along the high ground parallel to the Muskingum River stretched two great quadrangles and other geometrical earthworks, including a high circular mound.[133]

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[130] Ibid., pp. 194, 196.

[131] Ibid., p. 196.

[132] Ibid.

[133] Ibid., p. 198.

> In designing the city, Putnam incorporated some of the mound constriction in a most interesting manner, indicating his sensitivity to the strange remains built by the site's earlier occupants. . . . The street pattern followed the axis of the large rectangular mounds. The conical mound was retained in an open square on the axis of a street leading to the river. The processional way of the Indians became a very wide street and was given the name of Sacra Via.[134]

In 1820, the Indiana state legislature appointed a commission to select a site for the new state capital. After a site was chosen a second commission was appointed to prepare the town plan. Alexander Ralston, who had been one of the surveyors under L'Enfant and Ellicott at Washington, was asked to plan for the new city of Indianapolis.[135] In 1821, Ralston completed his survey and design work (see Figure 26).

> From the corners of a mile-square gridiron he laid out four diagonal avenues which converged to the intersections of four streets near the center of the city. . . . The influence of the Washington plan of 1792 shows not only in the pattern of streets but in the names honoring other states in the union.
>
> Ralston had the good sense not to bring the diagonals together at the center but to terminate them some distance apart. Nor was his plan surveyed without regard to topography. Along Fall Creek in the southeastern part of the city Ralston departed from the otherwise symmetrical pattern and planned two streets paralleling the creek. . . .
>
> . . . . . .
>
> His plan was less satisfactory where the diagonals crossed the intersections of the gridiron streets. Instead of cutting back the sharply pointed lots at this point or providing smaller circles or squares as L'Enfant had done, Ralston retained the precise corners resulting from the geometric pattern. Some of the city's present traffic problems stem from this failure to modify the scheme at these intersections.[136]

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[134] Ibid.

[135] Ibid., p. 205.

[136] Ibid., pp. 206-207.

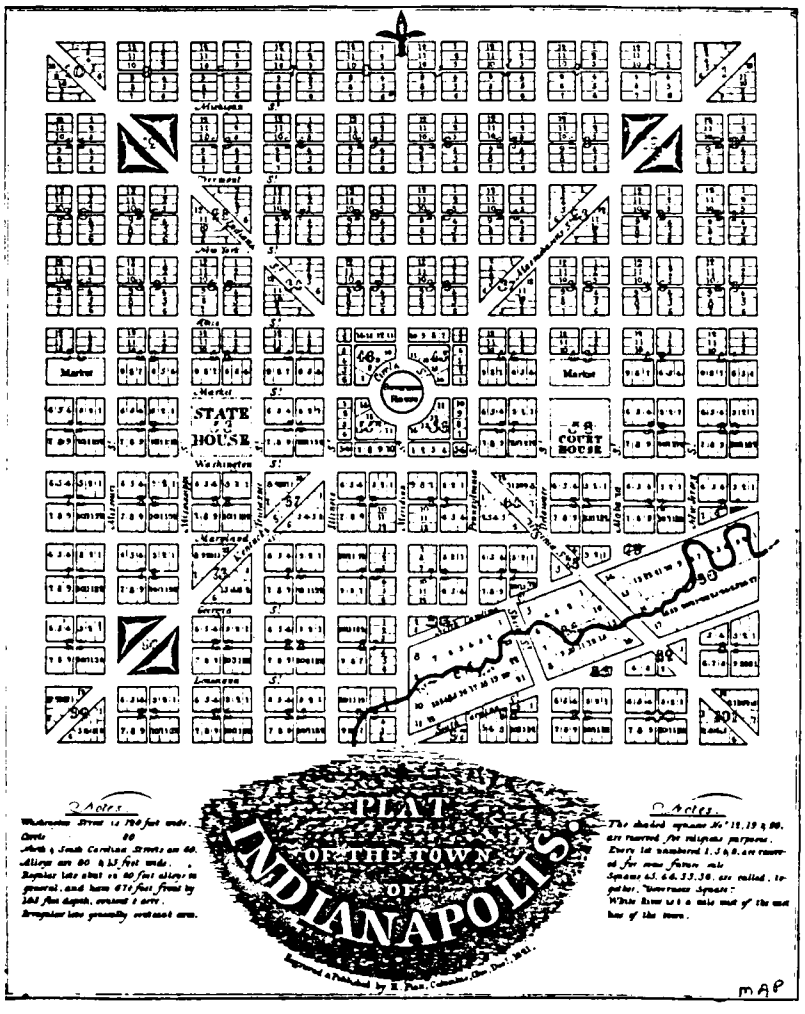


Figure 26. Indianapolis, Indiana.

Source: John W. Reps, Town Planning In Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 206.

Jeffersonville and Marietta were not the only early towns with distinctive street plans. Circleville, Ohio, also had an unusual street plan (see Figure 27). In search for an appropriate site to locate a new county seat for Pickaway County an appointed commission discovered:

> . . . another of the mound-building Indians' strange creations--a circle tangent to a square. They chose this unique site, and Donald Driesbach, who was directed to prepare the plan for the town, imaginatively conceived of a design that would utilize the circular mounds as the right-of-way for the principal street. He laid out eight other streets radiating outward from a central open space set aside for the courthouse. The name of the town was almost inevitable, and Circleville it became. In fact the circular portion of the town was actually a double octagon, thus permitting all properties to be bounded by straight, rather than curved lines.
>
> But like that of Jeffersonville, the plan of Circleville had but a brief life. Some of the more enterprising residents concluded that its design wasted otherwise valuable urban land between the circle and the enclosing square. . . .
>
> . . . . . .
>
> These persons approached the state legislature with a request to permit the replanning of the town, and in 1837 an act was passed authorizing the replatting of the circular portions of the town with the consent of the property owners.[137]

Esperanza, New York, was another city which had an unusual street plan. Founded in 1794, the city was designed in typical French baroque style. The street pattern was a combination of the traditional gridiron and radial/circular boulevards (see Figure 28). This was, of course, immediately after Washington, D.C. had been planned and as a result many features were imitated from the national capital.

Buffalo, New York, was developed by a group of Dutch bankers

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[137] Ibid., p. 207.

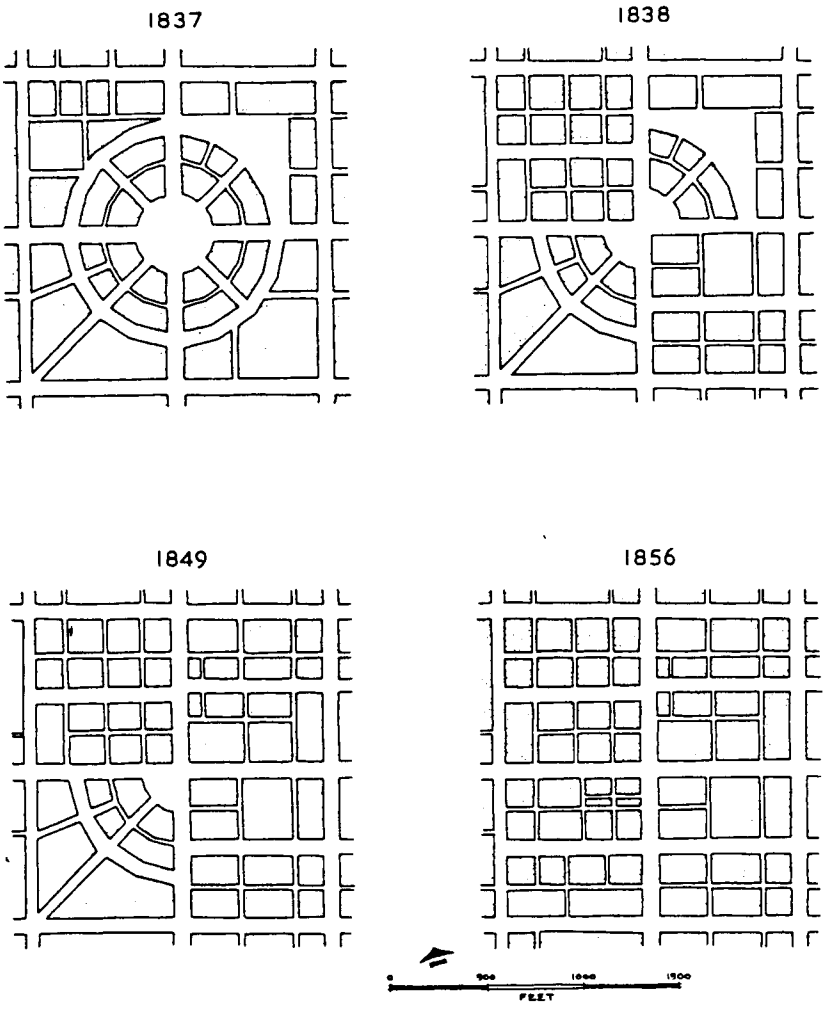


Figure 27. Circleville, Ohio.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 210.

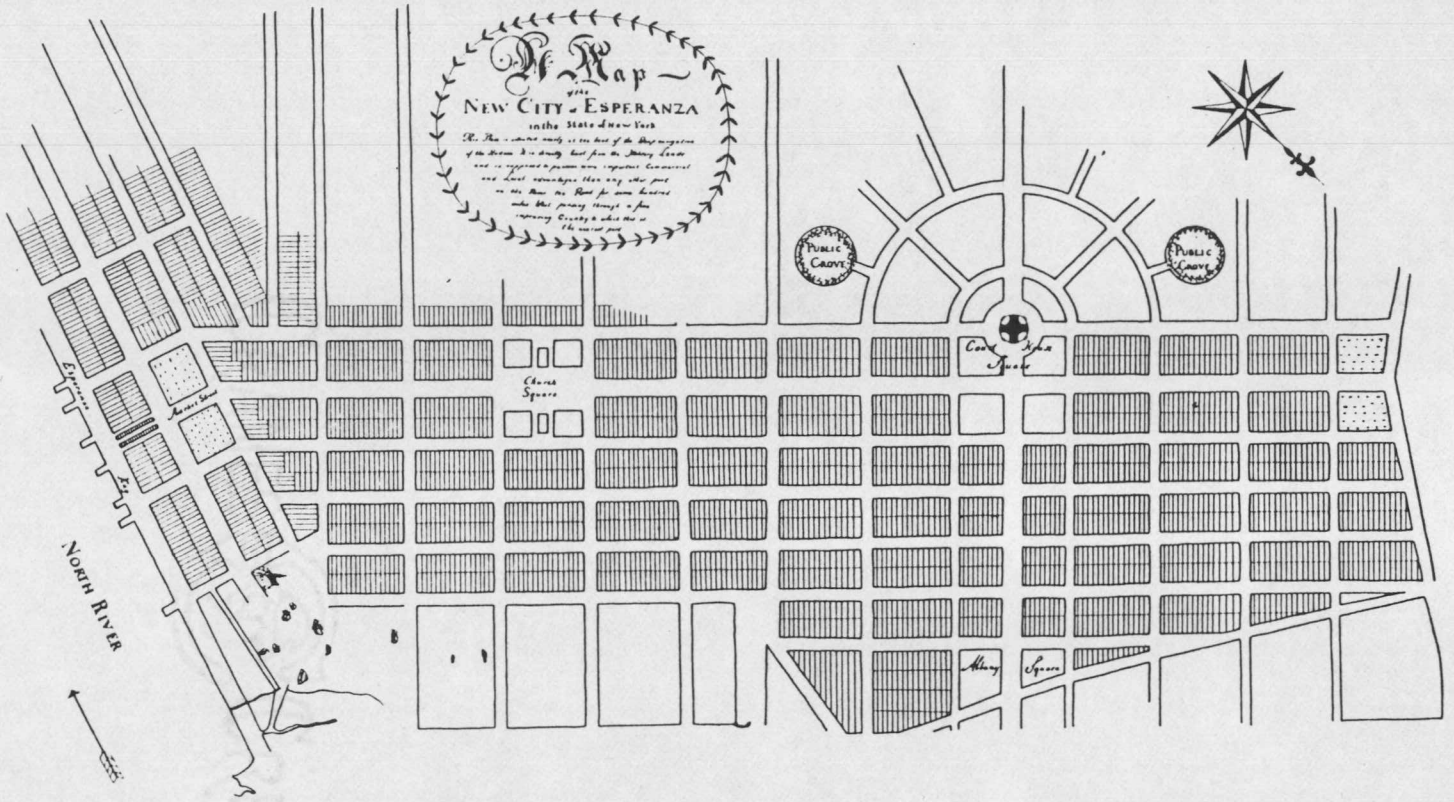


Figure 28. Esperanza, New York.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 239.

who formed the Holland Land Company. "The land agent for the Holland Land Company in western New York was Joseph Ellicott, the brother of Andrew Ellicott, who succeeded L'Enfant as planner for the federal city."[138] The street plan for Buffalo reflects the influence of L'Enfant's plan for Washington, D.C. a few years earlier. Joseph Ellicott laid out the plan for Buffalo in 1803 (see Figure 29).

> Ellicott's plan reveals to what extent he followed the diagonal street pattern used at Washington. From the corners of the central square four of these radial avenues extended to the edges of the city. Another pair of diagonal streets focused on a semi-circular open space located along one of the main streets.[139]

In 1796, a survey party under the direciton of General Moses Cleaveland laid out a township grid on the shore of Lake Erie. Thus was the beginning of Cleveland, Ohio. The city's original street pattern was a typical gridiron except for the irregular roads leading down the bluff to the river's bank (see Figure 30). About 1835, another street plan for Cleveland was produced (see Figure 31). In comparing the two street plans, the reader will notice that diagonal streets and further subdivision of the original street plan were added in a course of forty years. Also, several additional gridiron subdivisions were platted in a variety of directions west of the river. These factors have created many traffic circulation problems present in central Cleveland today.

In 1807, the Reverend David Bacon designed an unusual street

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[138] Ibid., p. 242.

[139] Ibid.

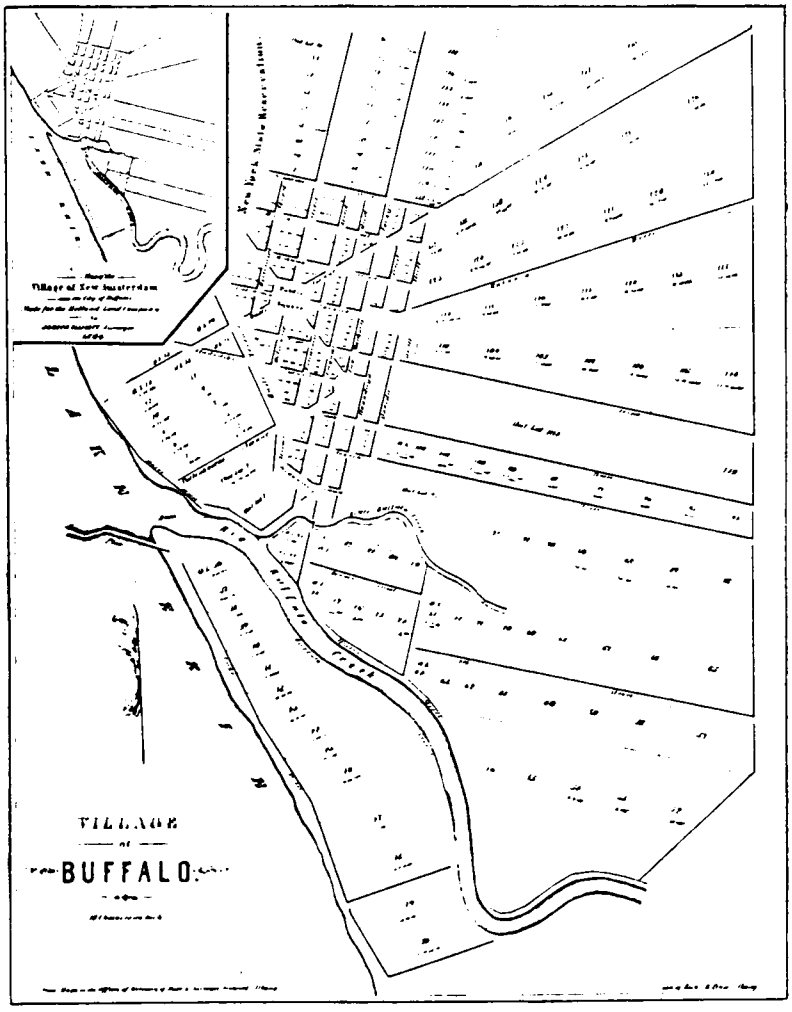


Figure 29. Buffalo, New York.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 243.

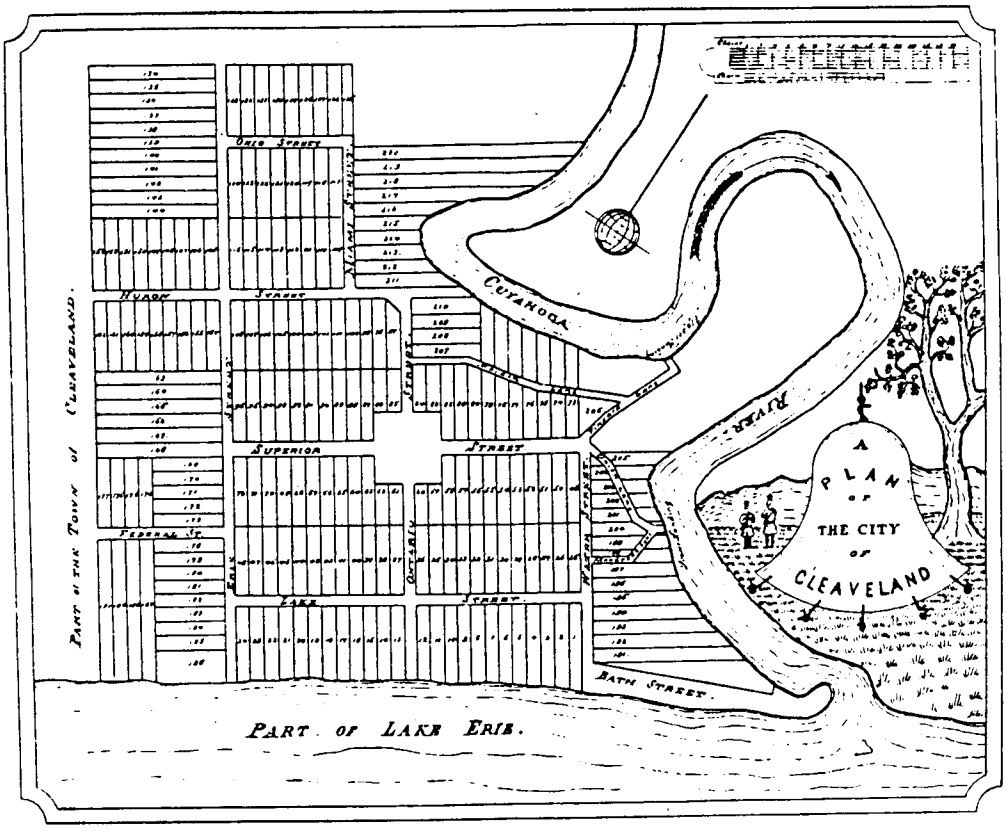


Figure 30. Cleveland, Ohio, in 1796.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 245.

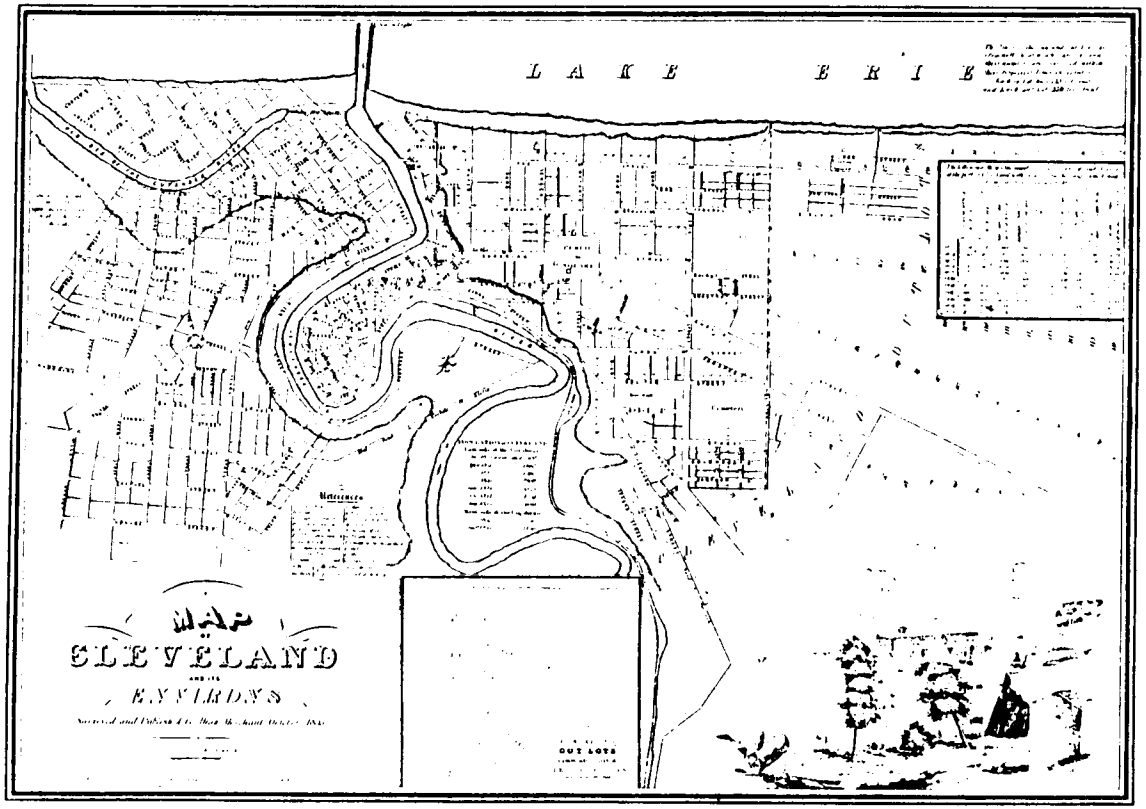


Figure 31. Cleveland, Ohio, in 1835.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 247.

plan for the township of Tallmadge, now a suburb of Akron, Ohio. With the idea of establishing a kind of religious commonwealth, Reverend Bacon's plan for the township and the village at the center was based on his belief that all settlers should be in close communication and that the church in the village should be the focus of the entire settlement.[140]

> He had the township divided into sixteen squares of 1,000 acres, each with 66-foot wide roads at the boundaries of these mile and a quarter square sections. Then he boldly ran four roads diagonally from the corners of the townships toward the center, where they met at the village. From the rectangular village square, four other roads ran north, south, east, and west.[141]

Perhaps the most interesting street plan in the midwest could be found at Sandusky, Ohio (see Figure 32). The street plan was laid out by Major Hector Kilbourn. According to legend:

> . . . Kilbourn's plan for the city's streets and open spaces duplicated the Masonic emblem of an open Bible, mason's square, and open compass. In the plan, Washington Square is supposed to represent the Bible, and two pairs of interlocking diagonal streets resemble the square and compass. . . .
> . . . . . .
> The two chief diagonals were planned, strangely enough, to terminate at open spaces rather than at the sites designated for public buildings.[142]

Detroit, Michigan, was the site of one of the more unusual episodes in American street planning and design. It began on June 11,

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[140] Ibid., p. 251.

[141] Ibid.

[142] Ibid.

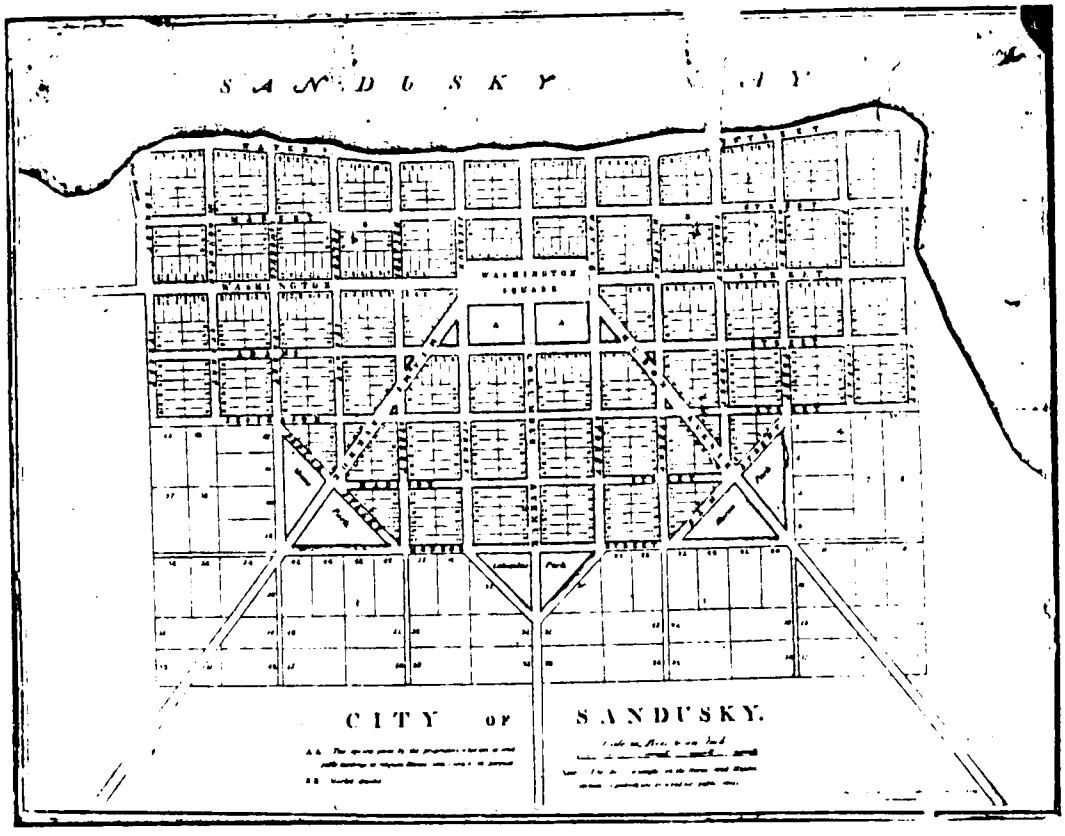


Figure 32. Sandusky, Ohio.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 253.

1805, when a tragic fire laid the frontier outpost to waste. Augustus Brevoort Woodward, a young judge, was appointed to prepare a new plan for the city. Woodward was required by Michigan state law to follow certain design guidelines. Specifically, the law stated:

> That the bases of the town of Detroit shall be an equilateral triangle, having each side of the length of four thousand feet, and having every angle bisected by a perpendicular line upon the opposite side, such parts being excepted, as from the approximation of . . . [the] . . . river Detroit, or other unavoidable circumstances, may require partial deviation.[143]

The plan Woodward developed is most remarkable (see Figure 33). He designed the city's street system in a vast honeycomb pattern. "The 'perpendicular line' divided each equilateral triangle into six right-angle triangles."[144] "Principal avenues were laid out north-south and east-west with widths of 200 feet. Other main streets were 120 feet wide, while minor streets were given the generous width of 60 feet. Every lot was afforded rear access from an ingenious system of alleys."[145] Woodward's plan is also unusual because to avoid sharp points at the street entrances he cut back the blocks to provide lots at more normal shape.

Unfortunately, Woodward's plan was rejected and shelved. A surveyor, James McCloskey, was appointed to prepare a revised plan using the traditional gridiron pattern. This plan, too, was also

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[143] Ibid., p. 255.

[144] Ibid.

[145] Ibid.

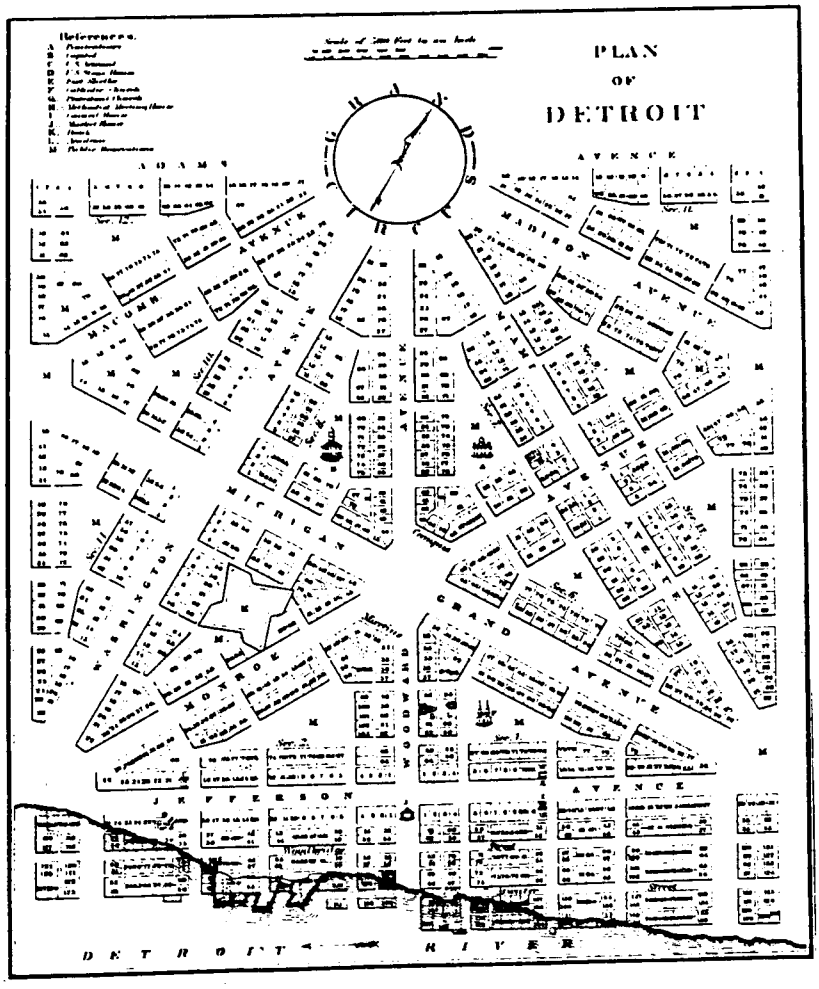


Figure 33. Detroit, Michigan.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 257.

never carried out. Finally, in the 1820's, a plan for Detroit was settled upon. It called for portions of the city to be laid out in a gridiron and the remainder to be platted in a web of diagonal streets, different from Woodward's street plan.

> The military tract where the fort had stood was turned over to city authorities and promptly platted in checkerboard fashion. Only a few of the original streets, the Campus Martius, and half of the Grand Circus, were retained. Planning was forgotten in the haste for expansion and land speculation.[146]

City Street Design in the West

In 1825, only a handful of tiny and widely separated urban settlements existed in the American West. During the next seventy-five years, a restless and land-hungry people swept across the western half of the continent, planning and building thousands of new communities in an unprecedented manner. Many of these cities were designed and built under French and/or Spanish influence. Virtually all of these cities used the gridiron street pattern in planning the street system. Below are some primary examples of the application of the gridiron in the American West.

In St. Louis, Missouri, the street plan for the city was a unique interaction between Spanish law and French custom. Founded in 1763 by Pierre Laclede Liguest, the city's gridiron street plan followed the ordinances specified in the Laws of the Indies. As required by the Laws, St. Louis was planned high atop the cliffs of the Mississippi River. Its gridiron street pattern was rectangular in

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[146]Ibid., pp. 259-260.

shape and linear in dimension. Virtually this same design had been used earlier in other French towns like Montreal, Canada; Mobile, Alabama; and New Orleans, Louisiana, where Laclede had assisted in their development and growth. After the French had secretly transferred the entire Louisiana Purchase to Spain, St. Louis began to grow beyond its original fortifications, extending its gridiron plan up and down the river and to the west. For years thereafter its plan became a model for many other western towns.

New Orleans, Louisiana, like St. Louis, developed a gridiron street plan adjacent to the Mississippi River (see Figure 34). After the Louisiana Purchase in 1803 by the United States, the city began to grow. "As occurred in many European walled cities, when the old perimeter fortifications were pulled down, broad boulevards replaced them: the Canal Street, North Rampart Street, and Esplanade Avenue to the present day."[147] Outside of these perimeter fortifications:

> The curving river bank suggested a new orientation for the grid plan of these city extensions, a change in street directions that could have been disastrous except for the skill with which connections were designed.
>
> Good planning and the influence of topography combined in another way to fashion a street pattern of beauty and interest as well as one that functions well even with modern traffic. As the long, narrow plantations adjoining the expanding community were subdivided, each was laid out in a little gridiron strip. But because the land back from the river was the least desirable owing to its location and its swampy character, the first subdivision of land occurred along the river. Each grid developed independently and rather slowly. Developers recognized the importance of short cross streets and arranged for connections across property lines.[148]

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[147] Ibid., p. 70.

[148] Ibid.

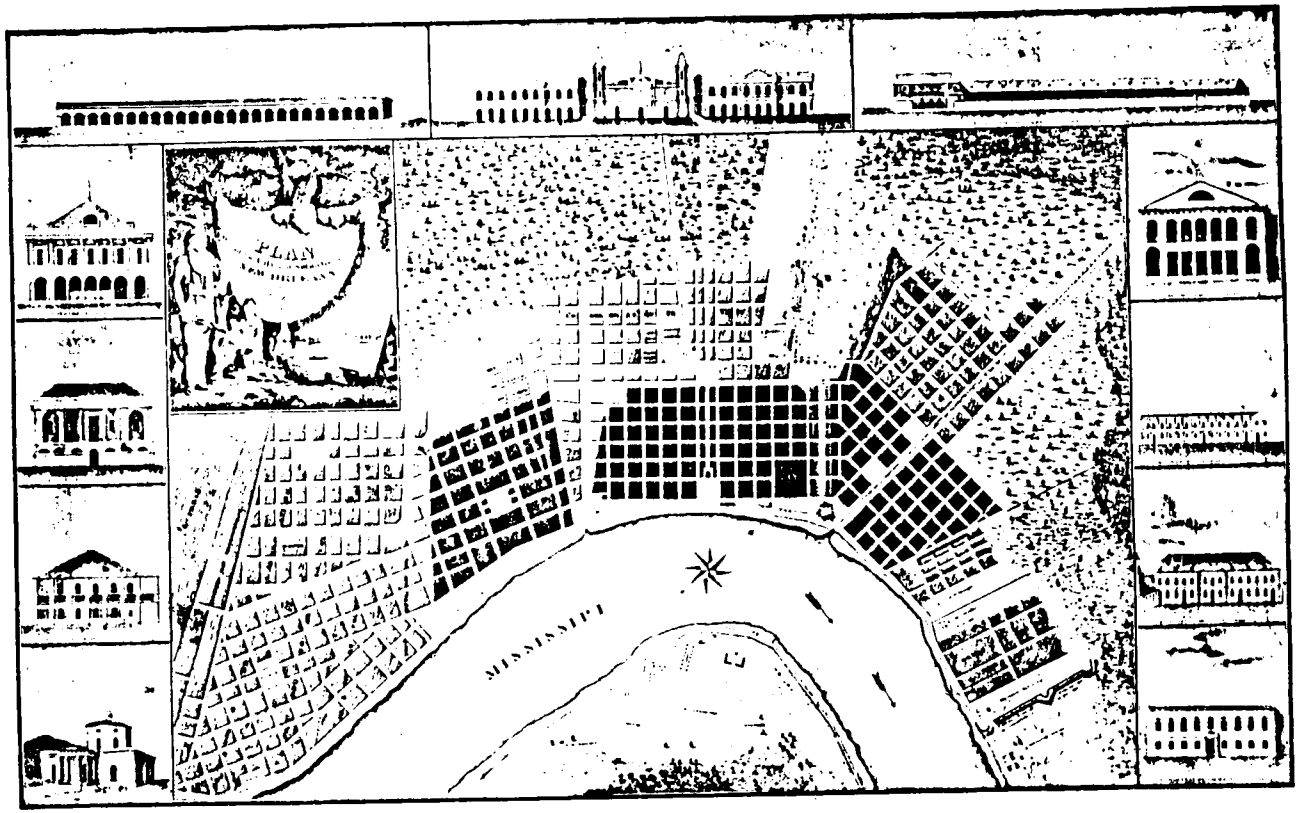


Figure 34. New Orleans, Louisiana.

Source: John W. Reps, Town Planning in Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 71.

Many cities in the southwest and the far west developed under planning guidelines of the Laws of the Indies. San Antonio, Texas; Los Angeles and San Jose, California; and Santa Fe, New Mexico, are the most prominent examples. Of course, all of these cities began with the gridiron street pattern in their early development. Santa Fe is recognized as "the ultimate expression of the city planning ordinances of the Laws of the Indies on the soil of the United States."[149] As the capital of New Mexico, Santa Fe's classic street plan has changed little since its founding in 1609 (see Figure 35). The plan shows the rectangular street pattern and the plaza as prescribed by the Laws of the Indies.

In San Antonio, the prescribed gridiron street pattern contained one additional requirement of the Laws, not often found elsewhere in the west. This was:

> . . . the orientation of the grid street so that the four corners of the plaza and of the blocks faced directly north, south, east, and west. This was intended to prevent the winds--supposed to come always from the cardinal points of the compass--from blowing unchecked down the town's streets.[150]

Los Angeles also developed a gridiron street system under the guidelines of the Laws of the Indies. One provision of those laws clearly specified that two streets should extend from each corner of the elongated rectangle formed by the main plaza and that wider main

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[149]Dora P. Crouch, Daniel J. Garr, and Axel I. Mundigo, op. cit., p. 70.

[150]John W. Reps, The Forgotten Frontier, Urban Planning in the American West Before 1890 (Columbia, Missouri: University of Missouri Press, 1981), p. 11.

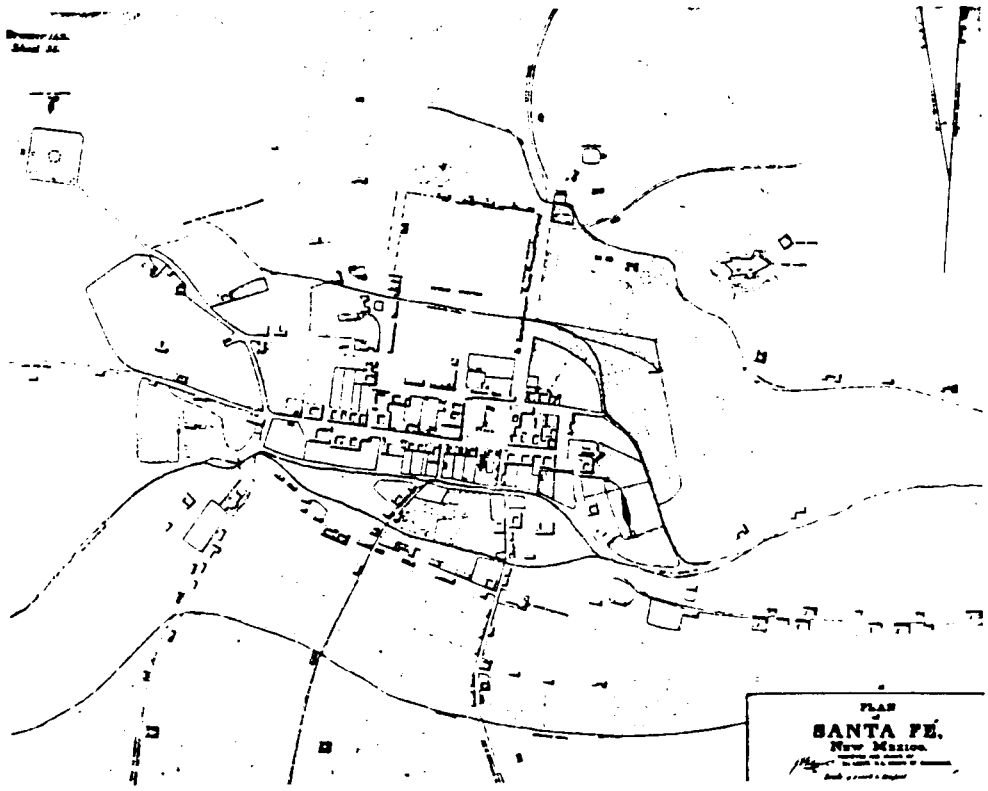


Figure 35. Santa Fe, New Mexico.

Source: Dora P. Crouch, Daniel J. Garr, and Axel I. Mundigo, Spanish City Planning in North America (Cambridge, Massachusetts: The MIT Press, 1982), p. 103.

thoroughfares should enter the plaza at the mid-points of each side, for a total of twelve streets emanating from the plaza. The 1781 plan for Los Angeles seems to represent an attempt to comply with this requirement (see Figure 36). The street plan's orientation also fulfilled the peculiar requirement that the corners of the plaza face the cardinal points of the compass.[151]

"As the town grew, however, it wandered away from the plaza by crooked streets, and houses were sometimes placed in the intersections."[152] In 1815, a disastrous flood swept away or badly damaged much of the little town. In moving the church and plaza to higher ground, an irregular setback line for the streets developed. This was corrected by reducing the size of the plaza, however, this created additional problems. For example, "one of the aristocrats living near the plaza was so obdurate about relocating his house that the main street had to detour around this property north of the church."[153]

> The flood then compounded the already existing vagueness over land titles and the imprecision of the lot boundaries. The ensuing confusion about public rights-of-way was addressed by a commission appointed in 1836 to study the arrangement of streets, alleys, and plazas. They were to "report a plan for repairing the monstrous irregularity of the streets brought about by ceding house-lots and erecting houses in this city." The commission recommended the drawing of a topographical plan of the city as it already exists, on which shall be marked the names of the street, alleys and plazas; also the house lots and common lands of the pueblo. Though the commission reported itself "amazed, seeing the disorder and manner how the streets run, more particularly the

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[151] Ibid., p. 15.

[152] Dora P. Crouch, Daniel J. Garr, and Axel I. Mundigo, op. cit., pp. 168-169.

[153] Ibid., p. 169.

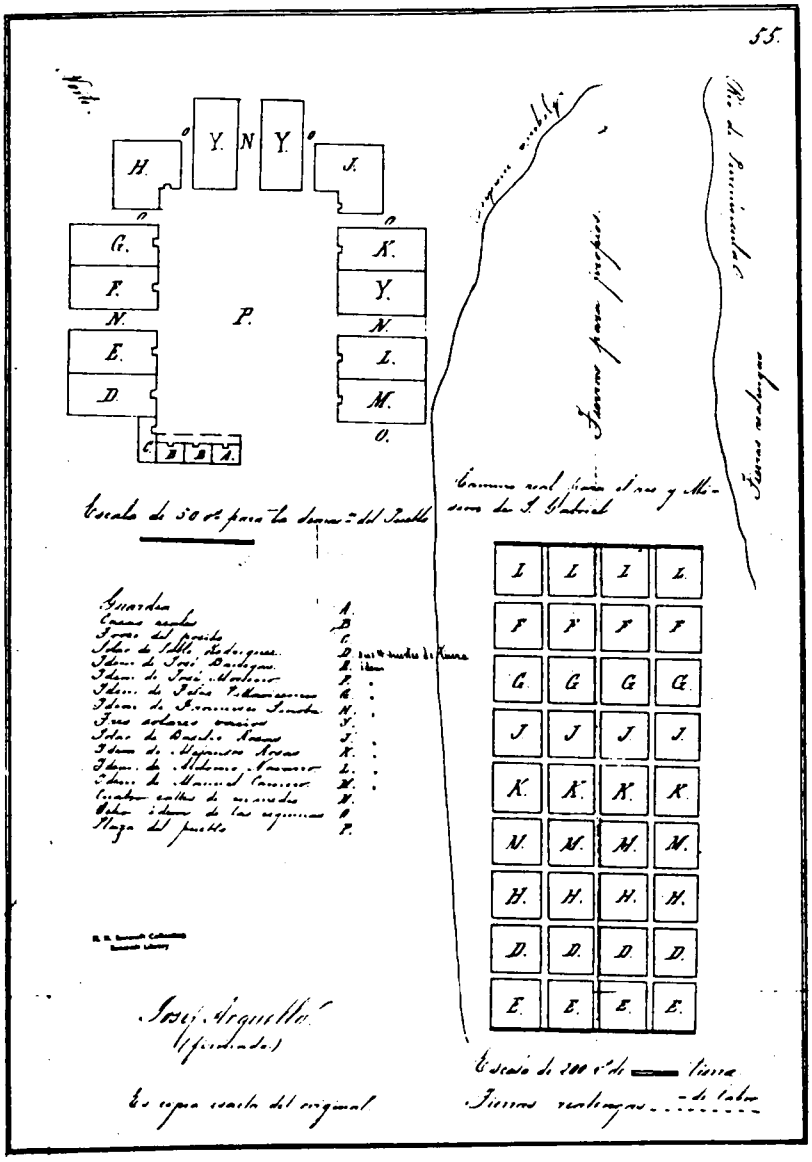


Figure 36. Los Angeles, California.

Source: John W. Reps, Town Planning In Frontier America (Columbia, Missouri: University of Missouri Press, 1980), p. 44.

> street which leads to the cemetery whose width is out of proportion to its length, and whose aspects offend the sense of the beautiful which should prevail in the city."[154]

Nothing became of the commission's report as the street system continued to develop in a highly unorganized manner. By 1850, the street system was more adapted toward the terrain, undulating with the marked differences of topography which existed in early Los Angeles.

San Francisco was not designed under the guidance of the Laws of the Indies, instead it developed from the economic whims of local town promoters. Again, the street pattern was a gridiron. Yerba Buena, the original town village, became the center of San Francisco's economic growth and development. The first two streets developed in the village were at acute angles to one another. However, Jean Jacques Vioget, a surveyor and local tavern keeper, was asked by Governor Figueroa, to enlarge the tiny village and provide a more orderly design. "Vioget's plan incorporated the two earlier streets and added a little grid below them with intersections that strangely missed being right angles by two and a half degrees."[155]

In 1847, Jasper O'Farrell, resurveyed San Francisco in a gridiron design to rid the city of the confusing acute angles of Vioget's plan (see Figure 37).

> As population increased, additional lots were needed, and city officials set O'Farrell to work again. He extended some of the street lines of his earlier grid into the water to create more

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[154] Ibid., pp. 169-170.

[155] John W. Reps, The Forgotten Frontier, p. 19.

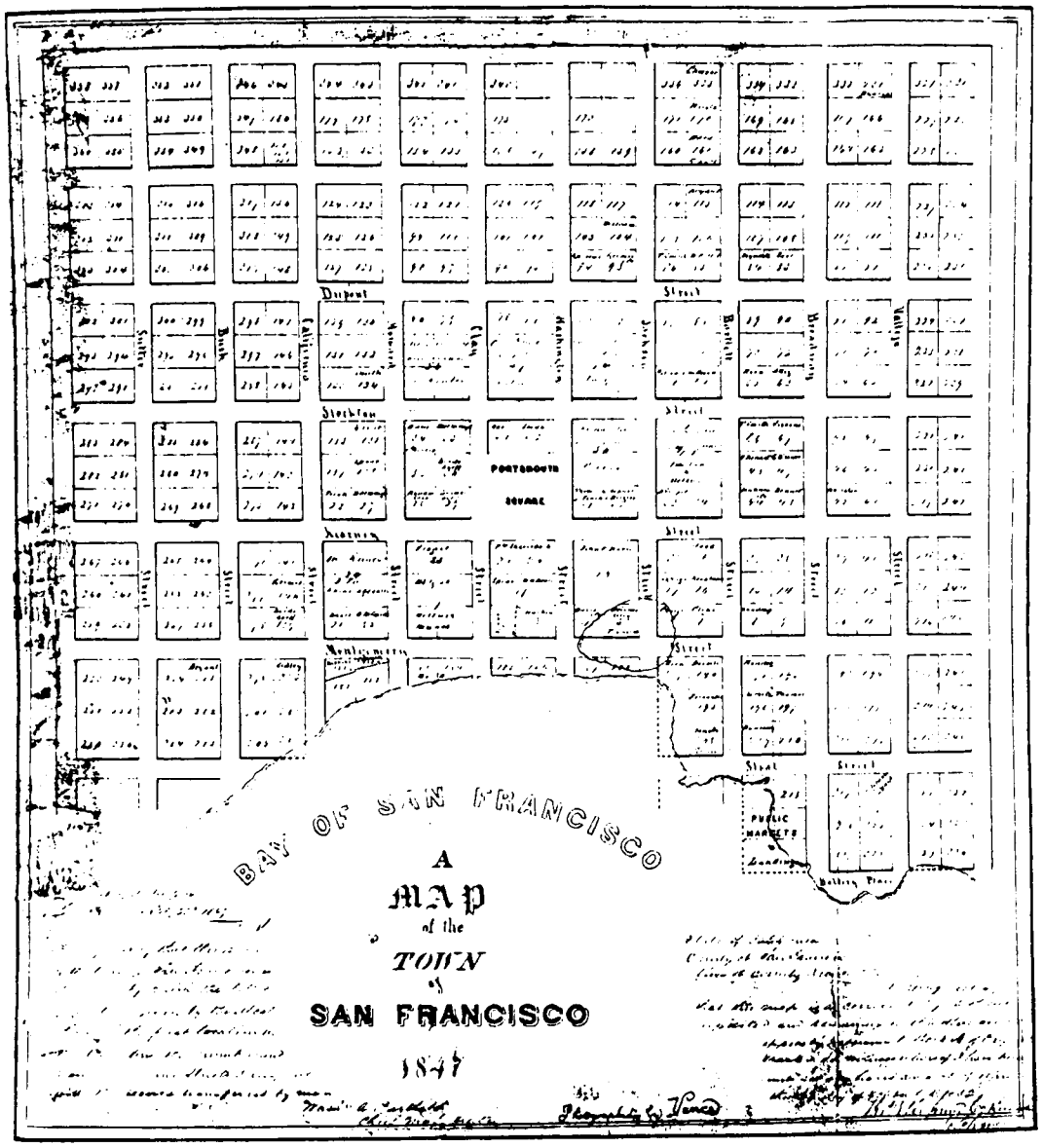


Figure 37. San Francisco, California.

Source: John W. Reps, The Forgotten Frontier, Urban Planning in the American West Before 1890 (Columbia, Missouri: University of Missouri Press, 1981), p. 110.

> building sites and added several blocks on the remaining sides of the town north, west, and south. Beyond the southern extension of his first grid he laid out a second grid system at a forty-five-degree angle to the first, building the two areas by Market Street, 110 feet wide.[156]

While promoters enjoyed the success of selling lots created by the mechanical grid, citizens complained bitterly to the city's administration, particularly to Mayor James Van Ness. They complained that:

> . . . the eye is wearied and the imagination quite stupefied, in looking over the numberless square--all square--building blocks, and the mathematically straight lines of the streets, miles long and every one crossing a host of others at right angles, stretching over sandy hill, chasm and plain, without the least regard to the natural inequalities of the ground . . . there is not even a circus, oval, open terrace, broad avenue or any ornamental line of street or building.[157]

> By 1868, the year before California and the East were linked by the railroad, San Francisco thus had received its basic urban pattern formed by a series of grids stamped across its steep hills as if the site stood somewhere on the plains of Kansas or Nebraska.[158]

Although the hilly topography might be thought ill-suited to such a rectilinear layout, this surveyors' expediency offered the only way of ensuring a degree of control over such rapid growth. Visually the result has been superb, San Francisco literally rises above the limitations of the grid.

Outside the influence of the Spanish government, numerous

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[156] Ibid., p. 107.

[157] Ibid., p. 112.

[158] Ibid., p. 115.

mining and logging towns developed in the Pacific Northwest and the Rocky Mountains. Although the gridiron was still the first choice of town promoters and planners, a variety of other street patterns were used in these communities. For example, along the steep cliffs of a gold mining district, Central City, Colorado, was laid out. Hal Sayre laid out the streets following the winding valley floors Gregory, Nevada, and Eureka gulches.[159] In Helena, Montana,

> . . . some of the irregularities of the plan are the result of topography, although most of them probably represent accommodations by the planners to sites already occupied and substantially built up that the buildings could not be removed [see Figure 38].[160]

Tacoma, Washington, was the site of one of the more interesting street plans in the west. In 1873, the Northern Pacific Railroad hired the famous Frederick Law Olmstead to prepare a plan for a new city that would serve as the Pacific terminus of the line. Olmstead developed a plan with curving streets leading across the contours to provide easy gradients to and from the waterfront.[161] The plan reflects the steep slopes he was asked to work with (see Figure 39). "It also, of course, represented Olmstead's fascination with the romantic plan forms that derived from English garden design and that he had used with such skill in the planning of New York's Central Park."[162] A

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[159] Ibid., p. 54.

[160] Ibid., pp. 54, 59.

[161] Ibid., p. 117.

[162] Ibid.

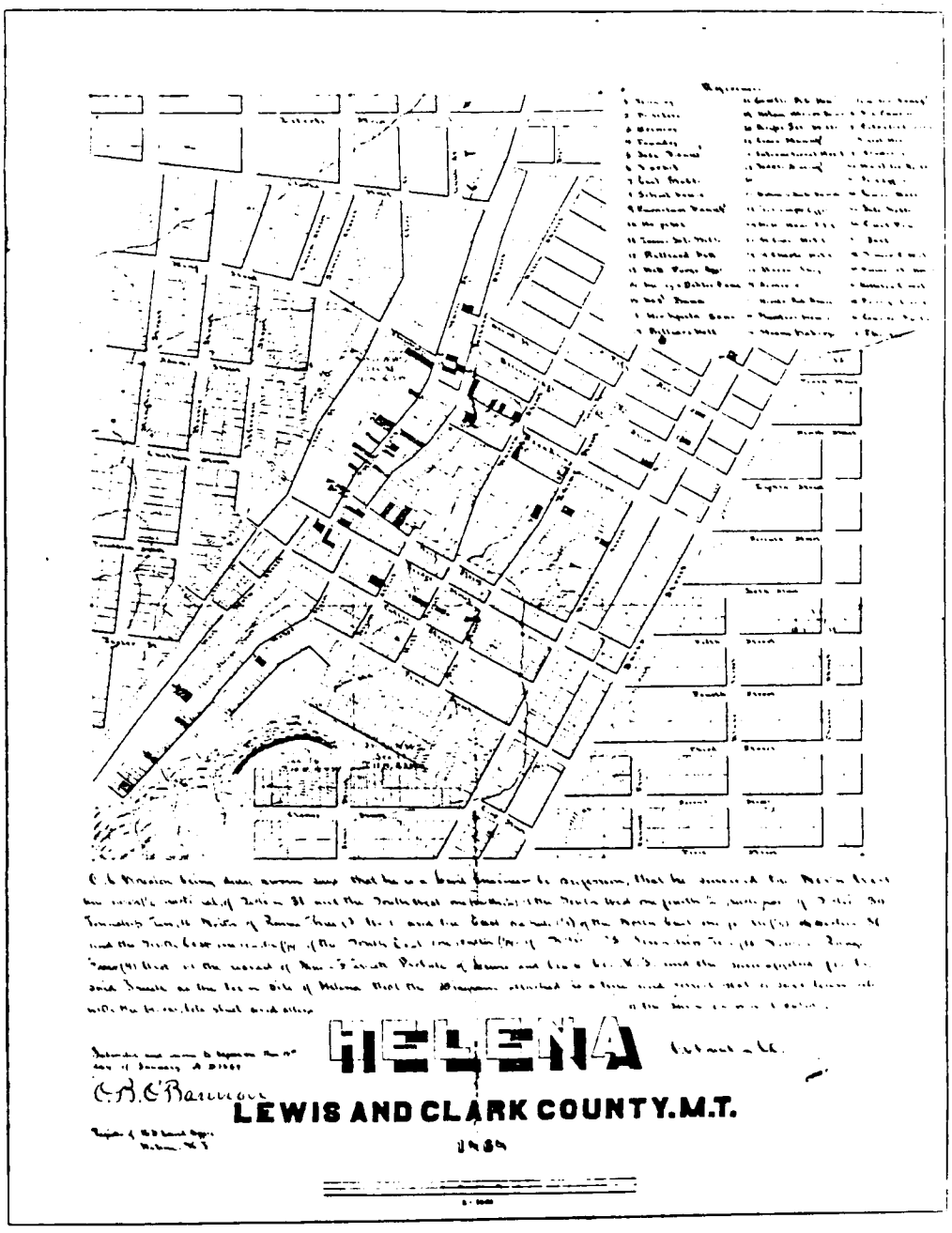


Figure 38. Helena, Montana.

Source: John W. Reps, The Forgotten Frontier, Urban Planning in the American West Before 1890 (Columbia, Missouri: University of Missouri Press, 1981), p. 58.

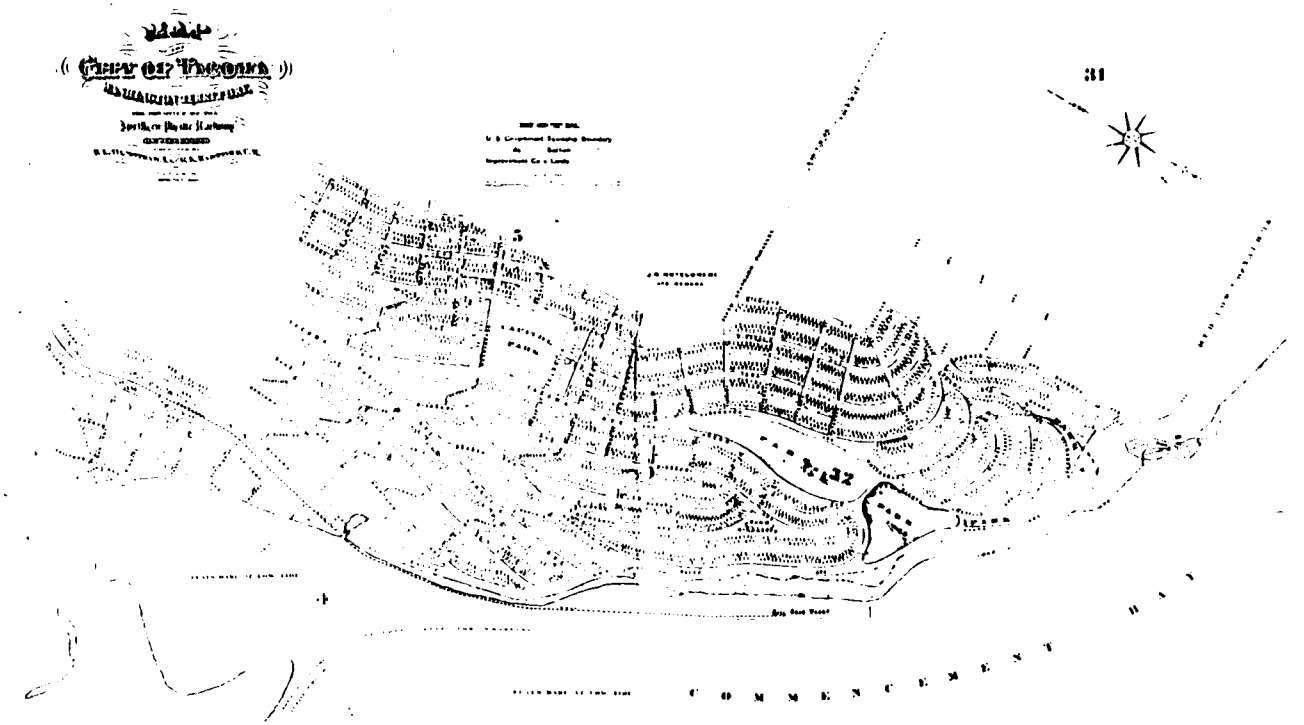


Figure 39. Tacoma, Washington.

Source: John W. Reps, The Forgotten Frontier, Urban Planning in the American West Before 1890 (Columbia, Missouri: University of Missouri Press, 1981), p. 120.

similar plan was also produced for Redondo Beach, California, in 1887 (see Figure 40). The exotic plan for Redondo Beach was created for developers in efforts to make their speculative town stand out as distinctive.

This concludes the discussion on the historical highlights of city street planning and design in America. Below is a brief history of road and highway planning in the United States along with an analysis of the effects of transportation's changing technologies on city street planning and design. Following is a brief synopsis of the history of road planning in the state of Tennessee.

Road and Highway Planning in America

As soon as American colonists established themselves, they began to develop a system of roads. "They had to go out into the country for more farm land, and they wanted to be able to travel from one settlement to another and from one colony to another."[163]

> Up to the time of the Revolutionary War, the public roads consisted mainly of horse paths and were suitable for carts and wagons only near the large centers of population. Gradually, these paths, which often followed the Indian trails or traces, were widened into wagon roads.[164]

> America was mostly rural people until well into the 20th century, and the roads of such people, except for the straight ones laid out in the process of getting the land surveyed, usually meandered, often along the ridges of high ground that Indians had used in getting from one stream to another.[165]

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[163] Fon W. Boardman, Jr., op. cit., p. 61.

[164] Radnor J. Paquette, Norman Ashford, and Paul H. Wright, Transportation Engineering, Planning and Design (New York, New York: John Wiley and Sons, 1972), p. 14.

[165] Christy Borth, op. cit., pp. 157-158.

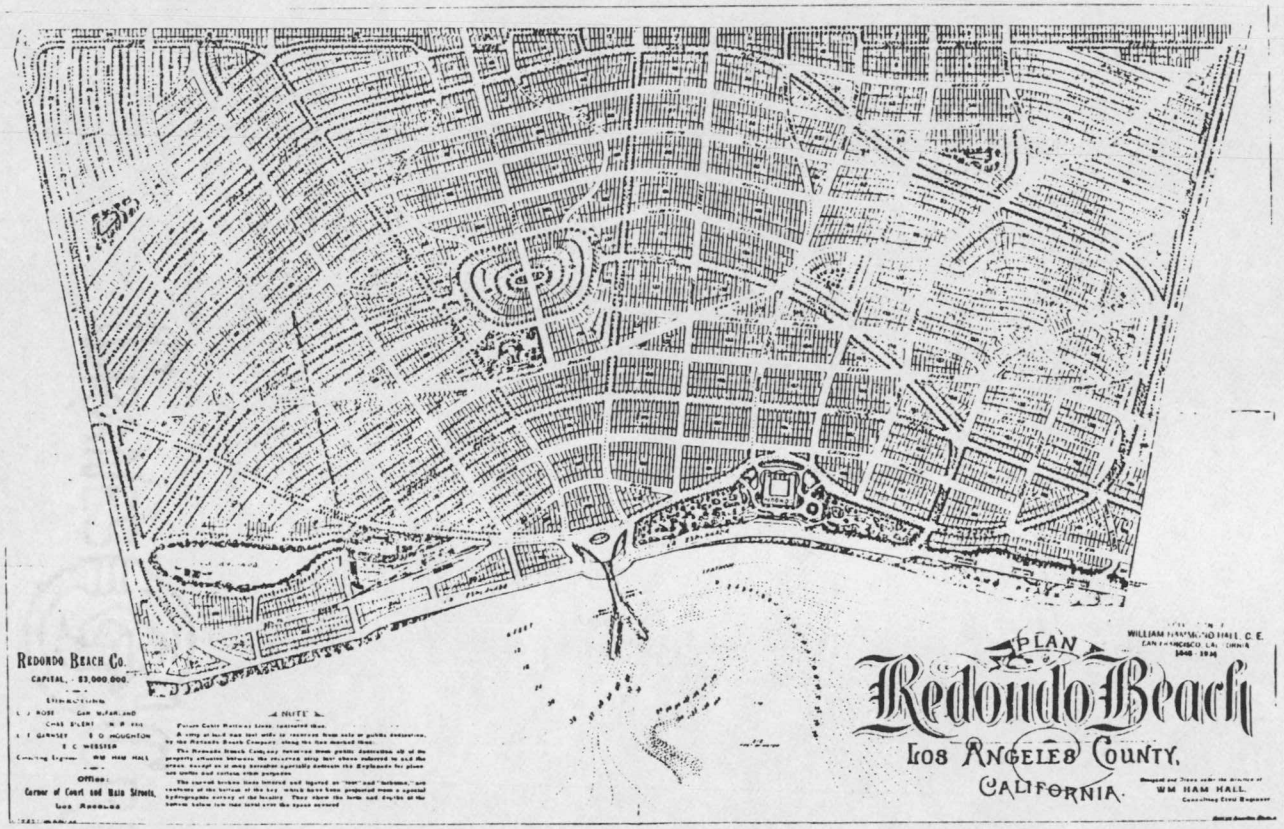


Figure 40. Redondo Beach, California.

Source: John W. Reps, The Forgotten Frontier, Urban Planning in the American West Before 1890 (Columbia, Missouri: University of Missouri Press, 1981), p. 102.

When Americans began migrating west, they used routes that animals, Indians, and explorers had followed before them.

> While many of the so-called Indian trails were probably formed by buffalo, deer and other creatures of the forest in their annual migration to the richest pastures or the best salt springs, the coordination of these paths into a crude system of general thoroughfares came as the natural result of the everyday necessities and inclinations of the nomadic races first inhabiting the land. . . . Both in directness of route and evenness in grade they have been improved upon but little by modern man in spite of the fact that swamps and other natural obstacles were circumvented. . . . The Indians used these trails on their hunting expeditions and missions of war.
>
> The first explorers, missionaries and traders followed the same paths in their intercourse with the savages; and after that the forest trail became the wagon road of the pioneer, and finally the turnpike or railroad of the modern man.[166]

Many famous routes such as the Oregon Trail, the Great Sauk Trail, the Pennsylvania Road, the Wilderness Road, the Boston Post Road, the Natchez Trace, and the National Road of the United States were developed along these primitive routes. These new roads assisted the rapid development of the original thirteen colonies, the midwest and the far west by providing access for trade, mail delivery and other essential tasks. The Appalachian Mountains proved to be the first significant barrier to maneuver around and provided some great challenges to early road planners and trail blazers.

A wide variety of new types of roads were designed and built in the New England and midwest regions around the turn of the nineteenth century. For example, post roads were created so that men could pick

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[166]John Austin Durrenburger, Turnpikes (Cos Cob, Connecticut: John E. Edwards, 1968), pp. 10-11.

up a package or a message and carry it on to the next station or post. The roads were designed to connect small towns with each other and to provide direct access between larger cities such as Boston and New York. The post roads were similar in character to those built in Europe and South America thousands of years earlier. Like almost all roads designed and built during the colonial period in the United States, the post roads were engineered to be efficiently straight to aid the delivery of mail and goods, and at the same time they were built with sensitivity to the physical constraints which were abundant. For example, many post roads ran parallel to streams and rivers which flowed at easy grades. However, with the coming of the Industrial Revolution, new forms of transportation supplanted much of the need for these roads.

> While trails and roads were carrying thousands of wagons and settlers from the east to the west in the United States and Canada, a great decline in road building and in the use of roads was taking place back east and, indeed, in all of Europe also. The reason was not hard to find: canals and railroads were doing a better job of transporting people and goods than roads and horse-drawn vehicles could.[167]

From the beginning of the nineteenth century to the turn of the twentieth century, the planning design of roads became of secondary importance to the promotion of railroads and canals. Congress granted massive rights-of-way to the builders and promoters of railroads and canals to construct these transportation facilities. For example, Congress granted railroad construction companies rights-of-way that

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[167]Fon W. Boardman, Jr., op. cit., p. 71.

were hundreds of feet in width to build their lines. Also, Congress gave alternate square-mile sections of adjacent lands to these railroad companies so that new communities could be built. Literally hundreds of these new towns were constructed, mostly with generous loans from the federal government. The placement of the tracks often dictated the design of the street system for these railroad towns. Typically a gridiron street pattern was developed perpendicular to the railroad tracks. Roads connecting these towns generally followed the established rail lines, taking advantage of the gentle slopes railroads were required to follow. Many of these roads served as feeders for the railroad lines and were of short distance.

Road planning and design in the United States came out of the Dark Ages with the invention of the automobile. As the popularity of the automobile increased, from 4,000 in 1900 to over 34,000,000 when the nation entered World War II,[168] new roads and highways were also built. The unparalleled freedom the automobile presented set in motion massive road building projects across the nation.

Four federally funded highway design and construction programs since the turn of the century stand out as the primary contributors to the development of street and highway systems in our states and cities today. These programs are: the Federal Aid Road Act of 1916, the Federal Highway Act of 1921, the Federal-Aid Highway Act of 1944, and the Federal-Aid Highway Act of 1956. Their impacts upon street and highway design and layout are summarized below.

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[168] Ibid., p. 74.

The Federal Aid Road Act of 1916. The Federal Aid Road Act of 1916 set the administrative framework for American road planning and construction in the twentieth century. "The 1916 act required every state, as a condition of federal aid, to establish a state highway department to plan routes, supervise construction, and maintain the roads that federal funds helped to build."[169] The 1916 Act was designed to coordinate the main interstate roads in the same manner that the previous state-aid road laws had integrated the country road systems. Also, the Act was created to assist in the design and construction of a good system of rural public roads. This was intended to aid the collection and delivery of the United States mail. The Federal Aid Road Act of 1916 was the first comprehensive piece of legislation aimed at the establishment of a nationwide system of roads.

As a by-product of the Federal Aid Road Act of 1916, the art and science of road planning and design advanced significantly. Prior to the adoption of the 1916 Act, road planning and design was carried out via a "direct method" of surveying. This direct method of road planning was achieved through field inspections and surveys. Road alignments were often decided upon on the spot. Railroad companies improved this method by pioneering a "topographic method" of route planning. In essence, the road planner would choose his desirable route(s) through an analysis of the topographical features of a route corridor. The locator would spread his topographic maps on a long

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[169] Sam Bass Warner, Jr., The Urban Wilderness, A History of the American City (New York, New York: Harper and Row Publishers, 1972), p. 38.

table, and he looked down upon them as if he were an observer in a balloon. When he was satisfied that he had the best location did he transfer the plan to the ground as his final location for the road. Also, because of the automobile, new design standards for roadway planning and design were developed. With the automobile's greater speed, previous standards for vertical and horizontal curves became obsolete and were adjusted. These scientific advancements were very important to the success of the Federal-Aid Road Act of 1916 in coordinating existing roads with new road planning and design, and provided momentum for future road planning efforts for the next sixty-five years. However, with the implementation of the Act there began an increase in urban congestion mainly caused by older street systems which were either poorly designed or designed for the slower movements of lesser volumes of vehicles, particularly horse and buggies.

> . . . as road building greatly expanded after the passage of the Federal Highway Act of 1916, the interstices of the metropolitan area began to be filled in. Complicated lateral movements of traffic became a defining characteristic of the metropolis. The transportation system of older cities, even after the automobile came into general use, still tended to funnel traffic into the center, greatly intensifying the problem of congestion.[170]

With the recognition of congestion in urban areas and on roads between urban areas, additional legislation for further road improvement became necessary. This began with the approval of the Federal Highway Act of 1921.

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[170]Charles N. Glaab and A. Theodore Brown, op. cit., pp. 252-253.

The Federal Highway Act of 1921. The federal-state cooperative relationship defined in the 1916 Act was made permanent in the Federal Highway Act of 1921. The 1921 Act strengthened many of the provisions of the 1916 Act by liberalizing the 50 percent federal-state matching funds by increasing the federal share of project costs, broadening the responsibilities of the state highway department, enforcing the coordination of road systems between counties and states, requiring state highway departments to adopt certain basic design standards, and establishing the formal definitions of interstate (primary) and intercounty (secondary) rural roads. The 1921 Act also assisted in increasing the scope for the funding and development of roads and trails within or partly within the national forests and national parks. The 1921 Act also provided the means for further research in highway design and planning. Products of this research included the development of aerial surveying which supplanted the costly topographic methods of landscape analysis, and the development of new safety and design standards for high-speed travel on roads and highways in the United States.

The Federal Highway Act of 1921 marked the beginning of the highway era in the United States. This piece of legislation provided the necessary impetus to build a variety of new interstate highways as well as the first modern parkways and express highways. This also marked the beginning of the "limited access" highway in which surface crossings were mostly eliminated, and cars could enter and leave the highways at many fewer places than in the past. The 1921 Act also gave guidance into the development of the first expressways and

freeways in urban areas. These fully "controlled access" facilities allowed high speed travel with very little interference. The implementation of these primary and secondary routes in urban as well as non-urban created many impacts upon the existing street and road systems of cities and urbanized areas. The most obvious impacts included: the restructuring of a hierarchical system of streets in a city, the many adjustments made to the physical street patterns, an emphasis placed on street systems to funnel traffic to these high-speed, high-volume facilities, and the creation of traffic control devices.

With the growing recognition of the need for more data for the planning and design of highways and roads in the United States, Congress enacted the Federal-Aid Highway Act of 1934. This Act allowed monies to be spent on "surveys, plans, and engineering investigations of projects for future construction . . . on the Federal-Aid Highway system and extensions thereof or on secondary or feeder roads."[171] Much of this important information was used in the development of roads and highways for the national defense. Unfortunately, most of the planning efforts for these roads and highways came during the United States' involvement in World War II. Although the Defense Highway Act of 1941 was enacted, much of the planning and design work appropriated from this bill was centered around the vast highway system surrounding the Pentagon in Washington, D.C. and other

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[171]United States Department of Transportation, and United States Federal Highway Administration, America's Highways 1776-1976, A History of the Federal-Aid Program (Washington, D.C.: United States Government Printing Office, 1977), p. 268.

military bases. During the mobilization for the war, it was discovered that many of the roads and highways constructed before the war were not adequately designed for the special weight and turning requirements of these war vehicles. Again, revisions to the design standards became necessary. The federal government's grand plan of attack on postwar highway problems was embodied in the Federal-Aid Highway Act of 1944.

The Federal-Aid Highway Act of 1944. This Act added some important new provsions to existing legislation in the planning and design of roads and highways in the United States. Specifically, the Act authorized the creation of a new National System of Interstate Highways not exceeding 40,000 miles in length, a specific system of urban and secondary Federal-Aid highways, and a system of urban extensions of rural Federal-Aid highways. The most important section of this landmark legislation was the creation of a new National System of Interstate Highways. The system was to be "so located as to connect by routes, as direct as practicable, the principal metropolitan areas, cities, and industrial centers, to serve the national defense, and to connect suitable border points."[172] With the conclusion of World War II, the demand for new automobiles and single family homes changed the emphasis of the 1944 Act. The increasingly popular suburban lifestyle placed a greater need for new urban streets and freeways instead of a large interstate system. The 1944 Act failed to

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[172]Ibid., p. 277.

provide funding for its implementation and thus the project never got off the ground. Individual highway projects were planned for and designed but the total comprehensive system which was originally envisioned never materialized. Despite the fact that the construction of the Interstate system did not begin until 1956, the 1944 Act was very important in the planning and design preparation efforts which were undertaken. A new series of planning and design standards for the construction and operation of the eventual system was adopted.

The interim period from the 1944 Federal-Aid Highway Act to the year 1956 was marked by gradually increased Federal-Aid authorizations and by studies and preparation for a greatly enlarged Interstate program. This culminated with the passage of the Federal-Aid Highway Act of 1956.

The Federal-Aid Highway Act of 1956. The Federal-Aid Highway Act of 1956 marked the beginning of the largest road-building project on the face of the earth. The 1956 Act became the means to finally construct a system of highways that could be used to mobilize the nation's defenses. In fact, in recognition of its importance to the national defense, the system's name was expanded to the National System of Interstate and Defense Highways. The goal of this project was to build 41,000 miles of first-class highways which would be suitable to transport any type of military vehicle as well as the growing numbers of automotive traffic.

With the passage of the 1956 Act, many new provisions for the planning and design of the Interstate system were established. For

example, the 1956 Act provided annual authorizations totaling $25 billion through the fiscal year 1969 to accelerate completion. This was one of the most important objectives of the Act. Thus, for the first time in history, the completion of an entire highway system was provided for. As a result, city and county planning agencies could plan for the location of a new freeway-type facility years in advance. Impacts to the overall street system of an area could be dealt with effectively, if planned adequately. There have been many successes and failures with the implementation of this system.

The Act also required the Interstate system to be designed and built to uniform standards, adequate for anticipated traffic levels and speeds in 1975. Obviously, because of this standard many systems are presently out-of-date and are requiring expansion and rehabilitation or total reconstruction.

Congress also attempted to deal with the problems of route location by proposing that:

> Insofar as possible in consonance with this objective (prompt completion of the Interstate System), existing highways located on an interstate route shall be used to an extent that such use is practicable, suitable, and feasible, it being the intent that local needs, to the extent practicable, suitable and feasible, shall be given equal consideration with the needs of interstate commerce.[173]

In most cases this was not feasible because previous highways were constructed to standards below that required of the 1956 Act.

Interstate highway planners and designers were faced with the

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[173] Ibid., p. 472.

incredibly challenging problems of designing these new freeways without disruption of the natural and man-made systems. These problems became acute in the densely developed urbanized areas of the United States. Overlaying a new four- or six-lane freeway on the existing land use and street patterns of a city, without disruption to man's activities and property proved impossible to achieve. However, highway planners and designers of the 1950's, 1960's and the 1970's attempted to plan these facilities with sensitivity to the environment of an urbanized area. Much of this sensitivity for design was accomplished because a great deal of coordination and cooperation with local city planners, elected officials and the general public was achieved. President Roosevelt understood this need in 1944 when he addressed Congress by stating that:

> The location of the metropolitan highway system . . . is to be selected by a city or regional planning commission and coordinated with the existing street pattern and with plans made to alter the future development of the city. The overall plan is to be arrived at by the closest possible cooperation with the "highway, housing and city planning authorities, railroad, motorbus, and truck interests, air transport and airport officials, and any other agencies, groups and interests that may be in a position to exert a determining influence upon the future pattern and development of the city."[174]

Despite the massive planning efforts undertaken, the Interstate highway's impact upon the urban framework, particularly the street pattern, has been significant. Many of these impacts will be

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[174]Albert C. Rose, Public Roads of the Past, 3500 B.C. to 1800 A.D. (Washington, D.C.: American Association of State Highway and Transportation Officials, 1952), p. 85.

identified and analyzed in the discussion of Knoxville's street and highway system in Chapters III and IV.

In response to the continued urging to give greater support to urban street planning and design needs, Congress enacted the Federal-Aid Highway Act of 1968. This law gave birth to the creation of a new program, the Urban Area Traffic Operations Improvement Program. This program quickly became known as the TOPICS program, an acronym for Traffic Operations Program to Improve Capacity and Safety. It recognized that extension of the freeway system into urban areas had relieved traffic congestion on many arterials but, by the location and design of interchanges, had imposed heavier volumes on other arterials and city streets on which cities were not prepared to finance improvements. Many poorly designed streets and intersections were improved under this short-lived program. A lot of this slack was taken up by the 1970 Federal-Aid Highway Act in which a separate "Urban System" category of funding was established to assist in the redesign and rehabilitation of designated city streets.

Transportation Development and City Street Design

Transportation's technological changes over the last three hundred years have influenced the shape and pattern of growth in America's cities and towns. To trace the patterns made by the impact of transportation upon the system of American cities, it is convenient to divide this history into two distinct periods, before 1900 and after 1900. Not surprisingly, transportation's impact upon cities' street systems changed dramatically around the turn of the century

with the invention of the automobile, and is reflected in this analysis. Norman Bel Geddes, in his book Magic Motorways, notes the impact of transportation's technological changes on cities by stating:

> When the horse was discarded, the winding roads over which he joggled were not discarded with him. The automobile inhereted them. Some of them have been "improved" from time to time, but the basic features have remained unchanged. The result of pushing motor cars out over these old roads was at first simply a mild havoc and runaway horses, but later, the Traffic Problem. Today we are still rebuilding old roads that were constructed for another vehicle, instead of starting to build special roads for the special needs of the automobile.[175]

Until about 1850, American city steets were designed to accommodate the traffic movements of pedestrians, horse and buggies, and, wagons and stagecoaches. These were the primary modes used in normal daily travel. They moved at a slow pace and were extremely mobile. Most city streets and country roads designed for the day could handle these movements relatively easily, even in some of the more dense communities like New York and Philadelphia. The configuration of these street patterns mattered little for the movement of these modes.

As previously mentioned, the development of the railroad greatly impacted and directed the development of the street patterns for new railroad towns in the midwest and west. But what was its impact on previously established street patterns in cities? Its impact has been significant in many cases. Peninsulas and islands of houses,

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[175]Norman Bel Geddes, Magic Motorways (New York, New York: American Book-Stratford Press, Inc., 1940), p. 13.

factories, and warehouses were often isolated from the rest of the city by the placement of tracks. Railroads, due to their topographic constraints, often adopted former prime roads as their rights-of-way, and as a result, disrupted the street patterns of these cities and towns. Large rail yards for passenger and freight movement, as well as bridges, surface tracts also played havoc into the establishment of a sensible street system. As the popularity of the railroad grew with the industrial age, these considerations often took a back seat to the economic growth of a city.

The Emergency Relief Appropriation Act, approved by President Franklin D. Roosevelt on April 8, 1935, organized the first major attack upon the baffling problem of railroad grade crossings in cities. Through the medium of this legislation, Congress sought not only to provide work for the unemployed, but also to turn the rising tide of automobile-train accidents which had become a matter of growing concern to city planners, highway officials and road users. The answer was the design and construction of grade-separated bridges called "viaducts." These structures often replaced the missing links of roads and streets acquired through condemnation by the railroad companies. By a single major operation the construction of an over-pass of this type would do away with a prolific source of accidents as well as abolish the time-consuming delays of traffic caused by shifting trains.

But, large trains could not always conveniently be utilized within the limits of cities themselves, and charters of railroads, though generous in extending rights-of-ways privileges through cities,

sometimes forbade the use of steam locomotives on city streets and thoroughfares. The horse-drawn railway (omnibus) provided the first real answer to the problem of large-scale movement of people within cities. The omnibus and the electric street railway did affect the street patterns of many cities because new suburbs were able to develop. These new bedroom communities were often miles from the dense inner-city neighborhoods, and were very popular.

Sam Bass Warner, Jr., in his book, Streetcar Suburbs, determined that much of Boston's suburbs, namely Roxbury, West Roxbury, and Dorchester, were created because of the development of the electric streetcar. Boston, he points out, was still a walking city in 1850, with dense settlement extending outward only within a two-mile radius of city hall; a small minority of the rich maintained country cottages and estates some distances away. Horse railroads pushed settlement outward only about another 1/2 mile by 1873, and about another 1-1/2 miles by 1887, extending the edge of dense settlement to four miles from Boston's city hall. In the late 1880's and early 1890's, electrification rushed the area of convenient transportation six miles outward. It was in this latter period that the three communities became genuine suburbs. As a result of the suburban growth of the three towns, and in other directions as well, by 1900 the character of greater Boston had been transformed. Great expanses of land had become urban. "From 1870 to 1900 the grid street and frontage lot

system was the land plan that underlay almost all the building in the three towns."[176]

The cable car was another innovation in transportation technology which came into use in American cities. The cable car was particularly suitable for sharp street grades such as San Francisco, which developed a gridiron street plan over extremely difficult terrain. The cable car provided relatively swift transportation compared to the horsecar and in many ways reinforced the maintenance of the gridiron in cities, especially San Francisco. With this application already known to be effective, other steep hills were also developed in the illogical gridiron pattern, in hopes of receiving similar transportation services.

These transportation technologies created many impacts on America's city street systems, however, they were overshadowed by the invention of the automobile. At the time no one seemed to realize that a vehicle was developing which would revolutionize not only all transportation, but life in general. Convenience and speed of travel made the automobile an extremely desirable mode of transportation.

> All that three centuries of Americans had done in laying out, widening and brushing up roads suddenly became obsolete. Before this time, travelers had moved so slowly that it never really mattered whether their road was straight or not. No man or animal had ever struck directly across a range of mountains or a river when he could manage to travel around it. In the horse-and-buggy era, no great effort was ever made by road builders to alter or modify the natural character of terrain to reduce the distance between to points, or to smooth out large bumps and recesses. . . .

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[176] Sam Bass Warner, Jr., Streetcar Suburbs, The Process of Growth in Boston, 1870-1900 (New York, New York: Atheneum, 1976), p. 132.

> Roundabout routes whose delays had never mattered now harmed the straight-away effectiveness of the car. But this was not understood. The new car was pushed out on the old roads.[177]

Recognition of this technological revolution did not take place until 1916 when the first Federal-Aid Road Act was enacted. Until then, little planning or design work in urban and rural areas was related to the motor vehicle. An early attempt to determine street needs was made by Cook County, Illinois, in 1924. From this point on, though, city planners and traffic engineers devised new street pattern schemes and design principles in order to assist the movements of the automobile. The complex fields of transportation planning and traffic engineering were thus born.

In most cities today, streets are classified in four basic functional categories: freeway, arterial, collector, and local. Each of these street facilities have developed gradually over the last six years, creating a variety of patterns and configurations which mark our cities. Below is a brief examination of the history of these facilities and their impact on overall city street patterns.

Freeways. The freeway is essentially a pair of parallel roadways, each of which carries traffic in opposite directions, with complete separation from each other and free from all cross-traffic.

> The freeway appeared on the American scene during the early 1930's, with the construction of the Downtown Expressway parallel to the Hudson River in New York City, the Pulaski Skyway from

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[177] Norman Bel Geddes, op. cit., p. 27.

> Newark, New Jersey, to New York,[178] and the commencement of the great Chicago Outer Drive.
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> Many of these early roads were limited in scope, but they were designed for the unimpeded movement of vehicles by the shortest route between two or more points. The freeway may parallel existing streets or cut across their present pattern. It marks the beginning of a new form of artery which may aid in the solution of the traffic problem and create cells that ultimately frame the groups of neighborhood units as the city grows and is rebuilt. With the freeway a new urban form is emerging.[179]

This "new urban form" has blossomed into a variety of facilities which characterize our cities today. They have been categorized by their configuration as: 1) circumferential, 2) radial, 3) gridiron, and 4) organic. Many cities offer a combination of these freeway types because of the many physical and social constraints which abound affect the uniform application of these facilities. Unfortunately, many of the most destructive effects of freeways have come as a result of not respecting the patterns of existing streets or the buildings which line their way.

Freeway planning and design has also spurred the creation and development of other associated road facilities. These include: frontage roads, collector-distributor roads, and, of course, a myriad of interchange configurations.

Arterials. For urban arterial streets there are three common patterns which have been used in cities in the United States. These are: gridiron arterials, radial arterials, and circumferential

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[178] Arthur B. Gallion and Simon Eisner, op. cit., pp. 331-332.

[179] Ibid., p. 332.

arterials. Gridiron arterial streets have become the most prevalent type in most cities, particularly in newer cities with level topography. Current trends in urban development appear to favor the grid as the best street in that densities and levels of activity are tending to become more uniform and the dominance of a single major center is decreasing. Radial arterial streets were well suited to older cities where the central business district (CBD) has exerted a major influence on activity and travel. As traffic in the peripheral areas of a radial system became greater, the need for circumferential arterials was evident. These facilities were designed to handle traffic having neither origin nor destination at the center of the radial system.[180]

Arterial streets developed with the invention of the automobile. These streets emerged as the main traffic-carrying routes in cities until the freeway was invented and refined. Then, the arterial street's function became one of carrying large volumes of traffic to feed the freeway. Because of their importance in the function and development of a city, arterials often influenced the configuration and patterns of streets away from these main routes. For example, Washington, D.C.'s radial streets between the different branches of government developed into an important arterial triangle.

Collector streets.

The collector street is primarily a residential phenomenon, which filters traffic from local streets before their capacity is

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[180]JHK and Associates, op. cit., p. 3-12.

exceeded and then conducts it to arterials or to local generators such as shopping centers, schools, or community centers.[181]

The main function of the collector is to direct traffic from local residential streets to arterials or freeways. "The way in which collectors are located with respect to other street types and to the total street system is influenced by their function, namely collecting traffic from residential streets and conducting it to arterials."[182] Their design often followed the pattern of modern residential subdivisions. Typically, this would be in curvilinear configurations. In older city neighborhoods, streets were usually composed of arterials and local streets with no middle street designed or planned for. Collector streets were often created through the placement of traffic control devices such as stop signs and traffic lights. With the invention of the automobile, the collector street became a product of twentieth century technology and development.

Local streets. Local streets date back to the founding of America when rows of houses were aligned along a common path in Santo Domingo. From then on the local street continued to serve as a means of access for residential areas throughout the United States. It has also served as an access point for additional land uses and is the most flexible of all the streets previously discussed. Being the oldest type of street in the nation, it is hardly surprising that it

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[181]William I. Goodman and Eric C. Freund, eds., op. cit., p. 142.

[182]Ibid.

has been used in a variety of ways. Many of these patterns and configurations have been developed in the last sixty years in conjunction with America's shift to the suburbs.

Because of the flexibility, the local street has been twisted in many unusual but often practical configurations. For the purposes of selling lots and property, town promoters preferred the gridiron pattern. More recently, street designers have developed a variety of curvilinear street patterns in order to escape the monotony of the gridiron and provide a certain degree of discontinuity so that through trips on these streets would be eliminated. Within these curvilinear subdivisions loop streets, cul-de-sacs, stub streets, dead-end streets, and turnarounds have been used to add variety to the driving experience, and in many cases, to save money from additional construction costs for pavements and utilities.

Local streets have also been used in a variety of other patterns as well. Radial and organic street patterns were common in many cities prior to the development of the automobile. Alleys must be included within the local street category because of its function. Alleys have traditionally been designed as mirror images of the surrounding streets, paralleling the existing street pattern. These alleyways were designed to be flexible in its configuration and purpose, never attaining a status to warrant their own individual and unique patterns. Alleys often were crooked in configuration and narrow in width, usually bending behind the varying lot depths and buildings.

One of the most interesting uses of the local street was

developed in Radburn, New Jersey, in 1929. Clarence Stein and Henry Wright developed a new town based on the "super-block" concept (see Figure 41). The design principles of the super-block emphasized the separation of through traffic streets from local streets. Traffic streets surrounded rather than traversed the residential areas. The super-block concept also required that pedestrians and vehicles be entirely grade separated. As a result, Radburn's street plan contained some of first cul-de-sac and curvilinear street patterns in the United States. Radburn's plan provided a prototype for the green-belt towns created under President Franklin D. Roosevelt's administration in 1933. Greenbelt, Maryland; Greenbrook, New Jersey; and Greendale, Wisconsin, incorporated many of these super-block street pattern concepts in their designs.

C. STREET AND HIGHWAY DESIGN IN TENNESSEE

The history of street and highway design in Tennessee is a reflection of the events which have guided and shaped the development of the United States. Beginning with the early western migration movements through the Appalachian and Cumberland Mountains, Tennessee's first residents designed and built the first roads in the state. The roads first used by the pioneers usually followed old Indian trails, which in turn frequently made use of buffalo paths. Later these buffalo-Indian-pioneer trails became turnpikes and modern highways.

One of the earliest and most noted trails was the Wilderness Road marked by Daniel Boone through Cumberland Gap into Kentucky. The

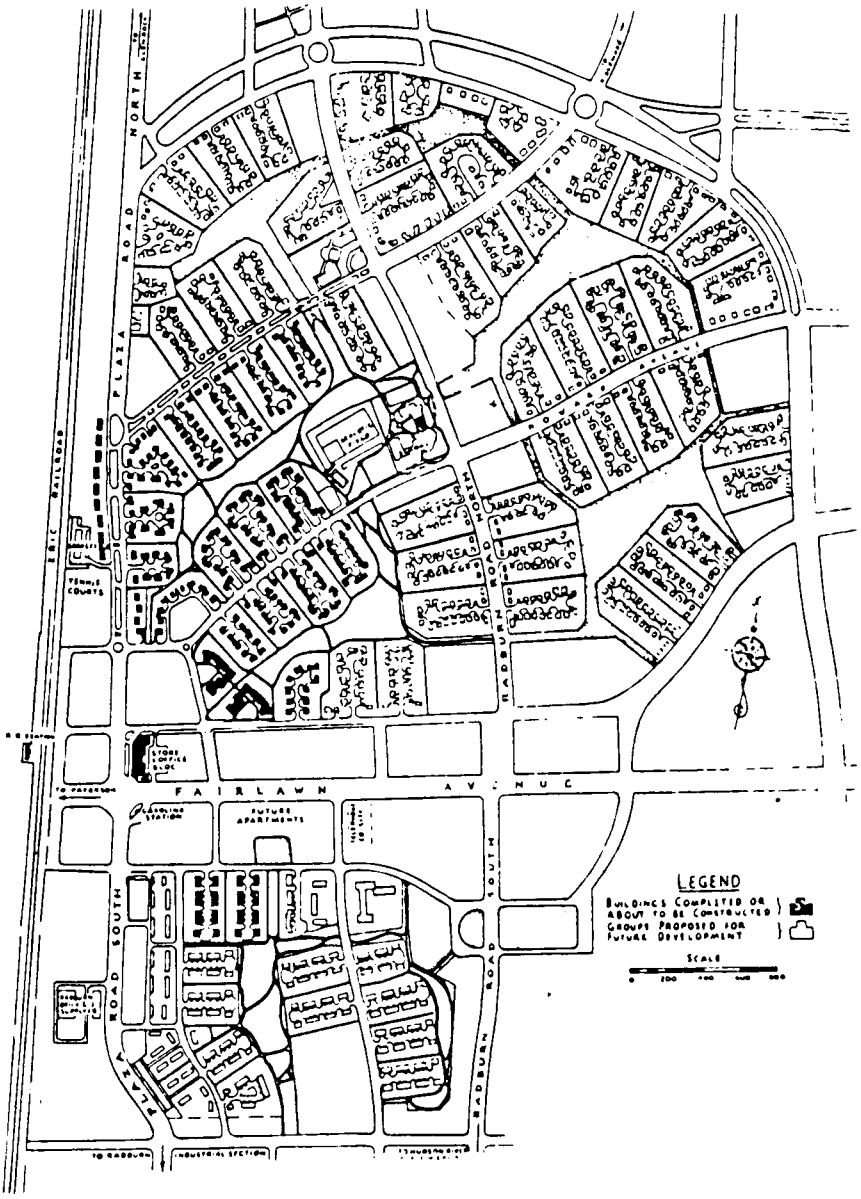


Figure 41. Radburn, New Jersey.

Source: Joseph DeChiara and Lee Koppelman, Urban Planning and Design Criteria (New York, New York: Van Nostrand Reinhold Company, 1975), p. 504.

Wilderness Road was an extension of a trail down the Holston River Valley through southwestern Virginia over which early hunters and settlers had passed. Later it became a wagon road and one of the most important migration routes in Tennessee. In the late 1770's a wagon road was opened from Burke County, North Carolina, across the mountains to Jonesboro to assist in the settlement of East Tennessee (then still part of the state of North Carolina). Around the turn of the nineteenth century another famous road, the Natchez Trace, was constructed. Upgraded from a buffalo path, the Natchez Trace was originally built as a United States government military wagon road. The Natchez Trace was later upgraded to a Scenic Parkway for automobile travel.

The population of Tennessee was rapidly increasing and facilities for traveling became a necessity for the state's cities and counties. Hence, in 1804, an act was passed by the legislature to empower the county courts to lay out public roads, build bridges and establish ferries. Efforts were also made, and not without avail, to interest Congress in the construction and maintenance of roads in Tennessee. Later,

> In 1821, the legislature directed that all public roads be divided into three classes: 1) stage roads or roads of equal importance, 2) second class wagon roads, at least twelve feet in width and designated by the notches on trees along the route, and 3) roads merely of sufficient width to permit the passage of horse and rider, which were marked with only one notch on wayside trees.[183]

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[183]Stanley J. Folmsbee, History of Tennessee (New York, New York: Lewis Publishing Company, Inc., 1960), pp. 372, 374.

The wave of interest in internal improvements which swept the country during the decade of the 1830's affected Tennessee along with the other western states and led to the adoption of a system of state aid to the improvement of transportation facilities, particularly wagon roads. These wagon roads were developed primarily as farm-to-market roads, often supplementing the emerging railroad lines (see Figure 42).

During the next seventy years road planning and design fell behind the impressive pace set by the railroads. Many turnpike companies went bankrupt because railroads could move farm goods and passengers more quickly than wagons and do it cheaper. Also,

> The counties too were expressing much dissatisfaction concerning the location and management of the turnpikes. It is widely believed that the companies were more interested in profit than plan and profile; and as a result of this loss of confidence, and after many years of complaining, the Legislature soon passed Acts prohibiting certain counties from participating in the building of turnpikes.[184]

Around the turn of the century, with the invention of the automobile, a new era of road planning and design was begun in Tennessee. By 1905 the legislature, conceived that the automobile was more than a plaything for playboys or a toy with the idle rich, proceeded to pass a law requiring registration of the automobile. The revenues from these registrations provided monies for some counties to build roads and streets. But still these roads were insufficient for

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[184]Tennessee State Highway Department, Highway Planning Survey Division, History of the Tennessee Highway Department (Nashville, Tennessee: United States Department of Commerce, Bureau of Public Roads, 1959), p. 13.

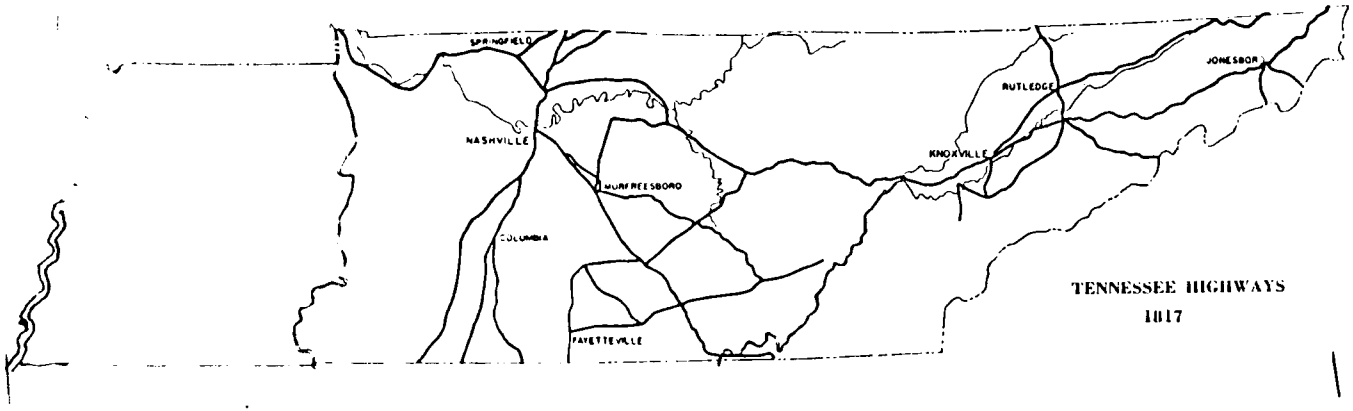


Figure 42. Tennessee Highways in 1817.

Source: Automotive Safety Foundation, Highway Transportation in Tennessee (Nashville, Tennessee: Tennessee Department of Transportation, 1955), p. 15.

the needs of the day. The Federal Aid Road Act of 1916 provided much needed federal funding in the establishment of a system of roads through Tennessee (see Figure 43). Subsequent federal and state legislation led to the development of a comprehensive network of streets and highways.

In the design of these facilities, road planners were particularly concerned with the many sets of mountain ranges which existed plus the subsoil conditions along with the location of lakes and rivers which are abundant throughout the state. Other factors affecting the placement of roads and highways included the differing land uses and population densities.

In 1955, the Tennessee Highway Study Commission declared that "About half of Tennessee's mileage of state highways, county roads and city streets is inadequate for safe and efficient travel."[185] Much of the current street and highway planning and design in Tennessee is directed toward the rehabilitation of these antiquated facilities, particularly interstate highways and city streets. These efforts have been mainly centered around the four major metropolitan areas of Memphis, Nashville, Chattanooga, and Knoxville, where heavy population growth has occurred.

In the next chapter, the study will focus on the historical development of the street and highway system in Knoxville and Knox County. Many of the factors which have affected the design and layout

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[185]Tennessee Highway Study Commission, A Summary Report...Highway Transportation in Tennessee (Nashville, Tennessee: Tennessee Highway Study Commission, December 1955), p. 3.

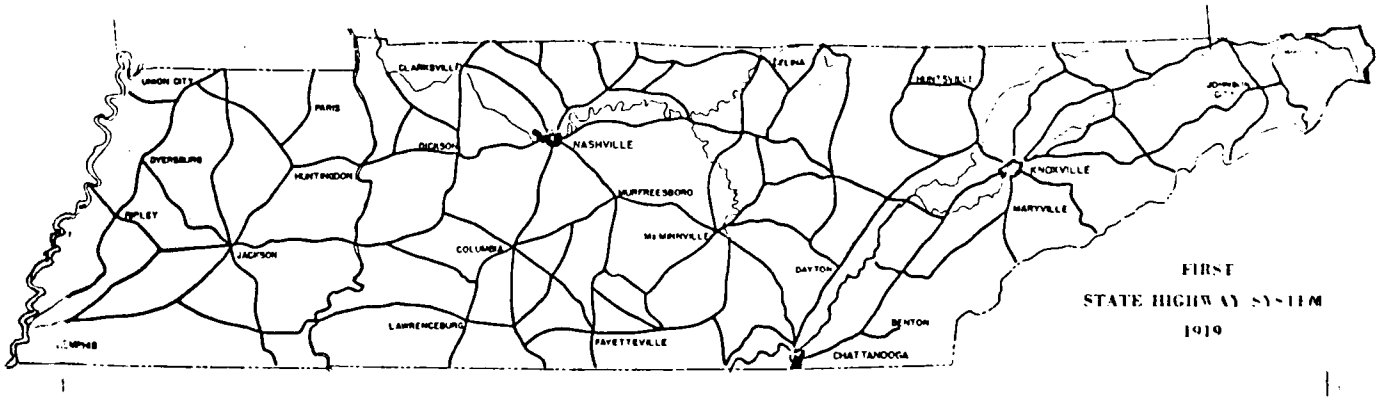


Figure 43. Tennessee Highways in 1919.

Source: Automotive Safety Foundation, Highway Transportation in Tennessee (Nashville, Tennessee: Tennessee Department of Transportation, 1955), p. 15.

of streets in cities across the nation and throughout the world also influenced the total configuration of Knoxville's street system and will thus be examined in detail.

CHAPTER III

THE HISTORY OF KNOXVILLE'S STREET AND HIGHWAY SYSTEM

The historical evolution of Knoxville's street and highway system is long and varied, covering most of two full centuries. During this period a number of important events helped shape the current configuration of the city's street and highway system. These events, some of national importance and some of local importance, provide logical breaks in this analysis. The chapter was divided into six sections, each falling into chronological sequence. Beginning with the original settlement period of 1791-1860, the historical evolution of Knoxville's street system was further divided into these eras: After the Civil War, 1860-1890; Around the Turn-of-the-Century, 1890-1915; After World War I, 1915-1940; After World War II, 1940-1960; and The Westward Movement, 1960-Today. Prior to these discussions will be a general overview of the paths and first roads which contributed to the founding and settlement of Knoxville. Many of these original facilities were later incorporated into the overall street and highway system as the city has grown and their influence on the total street pattern has been significant.

The Cherokee Indians of Tennessee and North Carolina were the first "road" builders in the Knoxville and Knox County region. They developed trails on their hunting and war expeditions, usually

following the trails previously marked by the trampling buffaloes.[186] It is important to note that the Indian trails usually followed the ridges, in order that the Indians following these trails might overlook the valleys, in which settlements were for the most part made. "Later, these buffalo-Indian trails were followed by the first white settlers in opening their pioneer roads."[187]

> The first important road through what is now the Knox County area was built by settlers moving into and along the Holston Valley by way of Jonesboro and Greeneville. This was extended beyond Knoxville to Campbell's Station, which is now Farragut, and by 1788 a horseback trail from the latter point was opened to developing settlements on the Cumberland River, on the western side of the Cumberland plateau.[188]

Another important road in the pioneer days of Knoxville was the original Emory Road in northeast Knox County. In 1785, the General Assembly of North Carolina passed a bill instructing the militiamen to "cut and clear a road by the most eligible route to Nashville making the same at least ten feet wide and fit for passage of wagons and carts."[189] The Emory Road was so heavily traveled that in 1787 the North Carolina Assembly authorized the militiamen to both widen and

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[186]Mary U. Rothrock, The French Broad-Holston Country, A History of Knox County, Tennessee (Knoxville, Tennessee: East Tennessee Historical Society's Publications, 1946), p. 90.

[187]Ibid.

[188]Lucile Deadrick, Heart of the Valley, A History of Knoxville, Tennessee (Knoxville, Tennessee: East Tennessee Historical Society's Publications, 1976), p. 185.

[189]Nannie Lee Hicks, The John Adair Section of Knox County, Tennessee (Knoxville, Tennessee: J-K Lithographers, 1976), p. 14.

level the road in order to accommodate the "vast emigration pouring into the country beyond the wilderness."[190]

> Shortly after Knoxville and Knox County had been established, the assembly of the Southwest Territory provided in 1794 for the holding of a lottery to obtain funds for the improvement of this trail (the route to Campbell's Station) into a "waggon road." It appears that this improvement had been made by the Summer of 1795, and it was reported that during the next season at least 300 wagons had passed over the road from Knoxville to Middle Tennessee.[191]
>
> The Knoxville-Campbell's Station segment was Knox County's first improved roadway. The fifteen-mile route, which was later extended to the Knox County line, was surveyed by Charles McClung. Its completion reduced transit time between the points from five to two and one-half hours and helped Knoxville become a trade center for local farmers and merchants. The road was the predecessor of what is now Kingston Pike. It originally was thirty feet wide and cut through heavy forests, a feat considering the county it traversed had a population of but two thousand people. Later it was widened to fifty feet and extended to the town whose name it bears. The first route to the Cumberland River was improved, the result of a 1799 act of the state legislature. It became known as the Walton Road and now is U.S. primary route 70 between Knoxville and Nashville.[192]

In designing the Walton Road, the State Legislature requested the President of the United States to appoint commissioners to mark out the road, following the "levelest way through the said country, paying as much regard to distance as shall accord with the convenience of passing the water courses at fords, and the mountains at the gaps most easy of ascent."[193]

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[190] Ibid.

[191] Mary U. Rothrock, op. cit., p. 91.

[192] Lucile Deadrick, op. cit., pp. 185-186.

[193] Mary U. Rothrock, loc. cit.

Other important roads developing during this period included:

> . . . a second road from upper East Tennessee from "Boatyard" (Kingsport) by way of Rogersville, Bean Station, and Rutledge to Knoxville (U.S. 11-W); a road from Knoxville by way of Clinton and Jacksboro to Cumberland Gap (U.S. 25-W and State 63); and a third by way of Maryville through the Cherokee country to Athens and Savannah, Georgia (original U.S. 129, later State 33, to Maryville).[194]

During the internal improvements era of the 1830's, Knox Countians became excited at the prospect of the federal government building a road from Washington, D.C. to New Orleans, Louisiana. This road would aid in the growth and prosperity of Knoxville and the area. Unfortunately, all hopes for this road "evaporated when President Jackson in 1830 refused to allow funds to be used on any road building project."[195]

Prior to the Civil War, road design and development tailed off significantly. Railroads took the fancy of many residents, and as a result, dominated the transportation scene for decades. River transportation also was very important in the growth and development of the area but did not affect the demise of local road construction as much as the railroad.

A. THE FOUNDING OF KNOXVILLE, 1791-1860

The historical development of Knoxville's street and highway system began in 1791 when Captain James White founded the town high

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[194]Lucile Deadrick, op. cit., p. 186.

[195]Ibid.

atop the cliffs overlooking the Tennessee River. White, who had acquired ownership of the land through the purchase from North Carolina under the land act of 1783, had the area of the prospective town laid into sixty-four lots of 1/2 acre each. Charles McClung was asked to survey and plat the new town. McClung's plan for the town called for the development of sixteen square blocks, four lots to a block, arranged in a gridiron configuration (see Figure 44). The gridiron street pattern was used to facilitate the sale of the building lots for the first settlers in Knoxville.

> The town was bounded on the south by the Holston River (now the Tennessee River), on the north by Fifth Avenue (now Church Avenue), on the west by Crooked Street (now Walnut street), and on the east by First Creek.
>
> In laying out the town James White, . . ., agreed ". . . that all the lands lying between said town and the river, one pole along the river bank excepted, and all land between the town and the creek, as far up as the southeast corner of Broad (now Main Avenue) Street with a street of thirty-three feet wide round the remainder of the town shall be a commons for said town."[196]

McClung's gridiron street plan for Knoxville was centered on a strip of land between First and Second Creeks. The town was placed there in order to provide good protection from marauding Cherokee Indians. Proximity to the river for trading and transportation was also a very important factor in the planning and design of Knoxville. This point is substantiated by the fact that all the original north-south streets ran to the water's edge, where many of the businesses were located. Unfortunately, most of the platted streets ran

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[196]Lucile Deadrick, op. cit., p. 70.

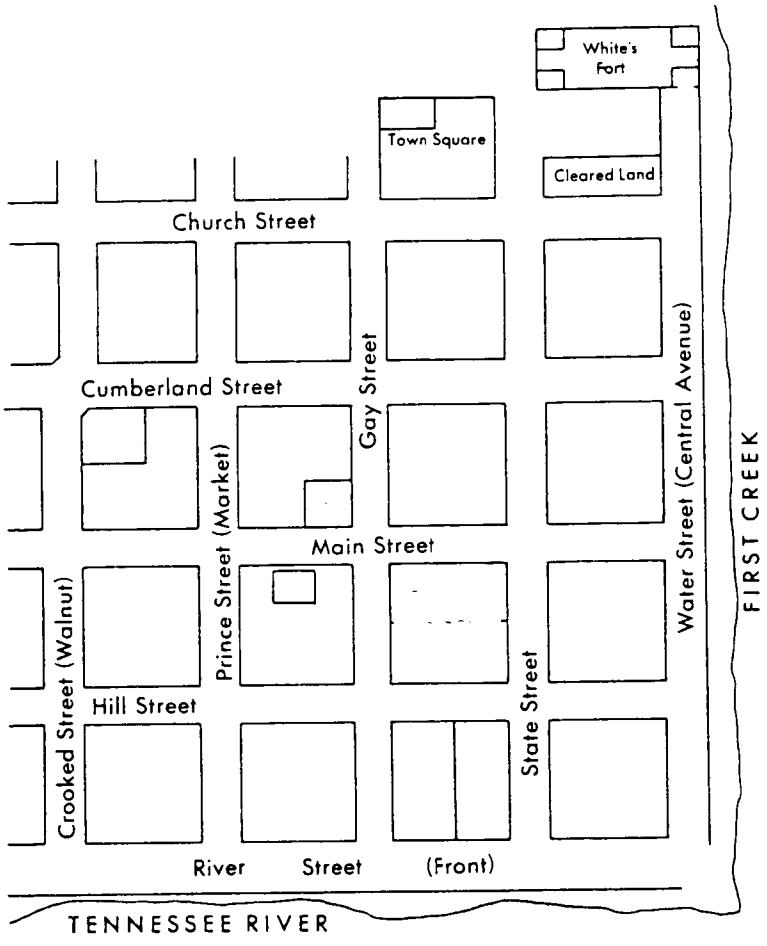


Figure 44. Knoxville in 1791.

Source: Betsey Creekmore, Knoxville (Knoxville, Tennessee: The University of Tennessee Press, 1958), p. 46.

perpendicular to the sharp contours of the cliffs and thus caused many difficulties in the movement of people and goods, particularly during the rainy Summer months and cold, snowy Winter months.

In 1794, one of the first laws passed by the territorial assembly was an act legally establishing the town of Knoxville. The establishment of Knoxville was important because the city could legally annex as much land as it needed to support the growth that was occurring at the time. Knoxville exercised its right to annex in 1795 when the city platted an additional street (Clinch Avenue) to the north, and two additional streets (Locust and Henley Streets) to the west of the city's original limits (see Figure 45). One thing to note about this annexation was the creation of the city's first street jog, at the corner of Walnut Street and Cumberland Avenue. The street jog occurred because Governor John Sevier requested Charles McClung to plat his property in the path of Walnut Street in order to impress the local townfolk of his power and influence. The street jog did not seriously disrupt the overall street pattern of the city, however, it did ruin the symmetry Charles McClung had hoped for. The blocks south of Governor Sevier's house were adjusted to minimize the effect of this special consideration. Development adjacent to the house, which occurred after the 1795 annexation, made this street design blemish all the more noticeable. Appropriately, Walnut Street was originally called Crooked Street.

In 1797, the Tennessee General Assembly provided for the election of commissioners for Knoxville in order to adopt rules to

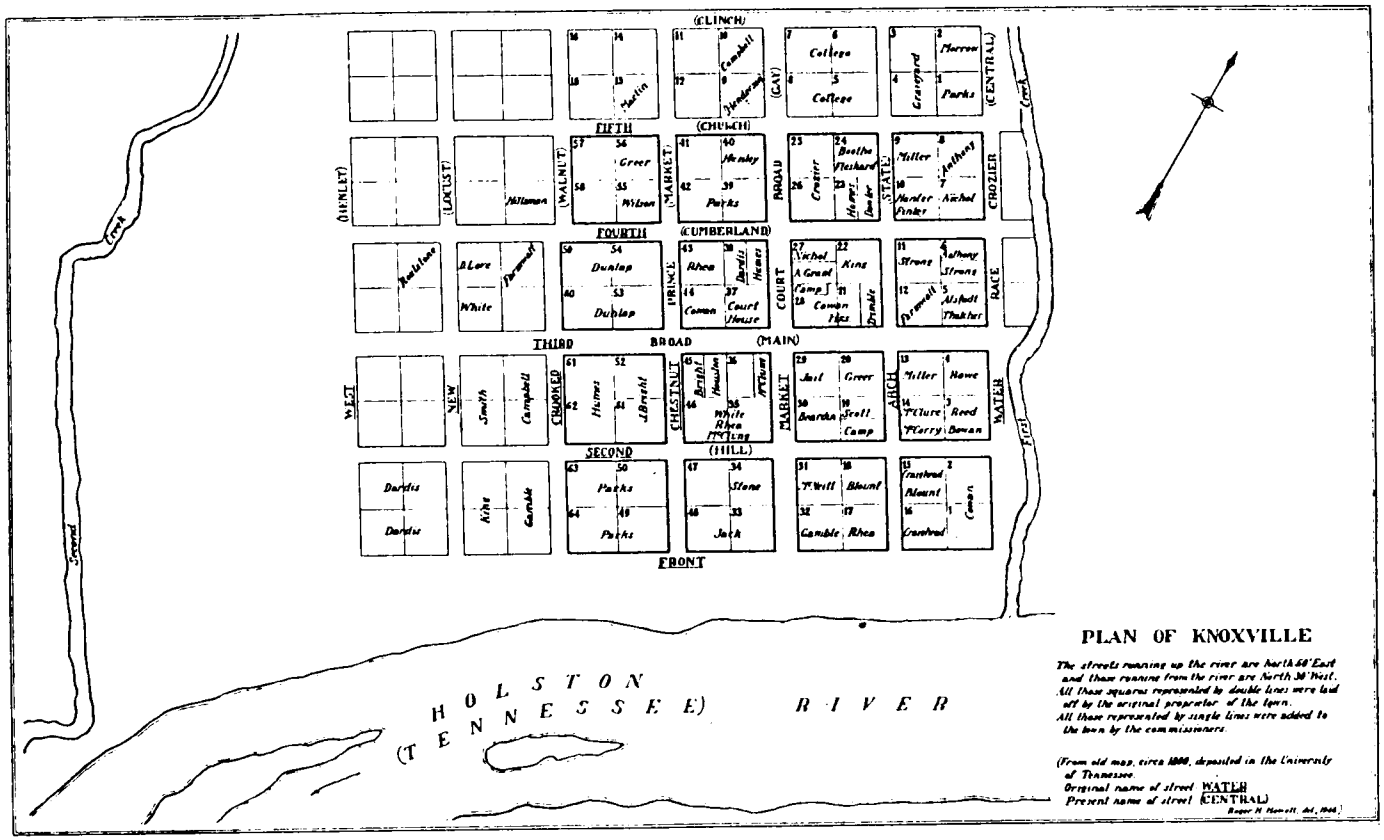


Figure 45. Knoxville in 1795.

Source: Mary U. Rothrock, The French Broad-Holston Country, A History of Knox County, Tennessee (Knoxville, Tennessee: East Tennessee Historical Society's Publications, 1946), p. 33.

regulate the town and enlarge it.[197] Their powers also allowed the commission to deal with the problems of the local street system.

> Streets were not surfaced and their location not clearly established. An early act of the commission in 1802 was to appoint a committee composed of commissioners May, Whiteside, and Campbell to report on streets "out of repair" and recommend methods for their repair.
>
> The committee report must have raised other problems for the commissioners because a month later a resolution was passed which stated that ". . . the manner in which the streets have been established by the late commissioners is not consistent with the original plan of said town. . . ." A resurvey was ordered ". . . to ascertain the original plan and make any alteration in the same that appear proper and consistent with their powers."[198]

According to census materials of the day, Knoxville's population growth was slow but steady. "By 1815, for example, the Knoxville population was approaching one thousand but Knoxville's population represented less than 7 percent of the total population of Knox County."[199] The significance of these statistics indicates that Knox County, in 1815, was very rural, and that Knoxville did not capture all of the growth occurring in the area. Little communities often developed around Knoxville, typically along the previously established roads from the northeast and west. These communities contributed to the development of an overall street pattern for Knoxville and Knox County. Some of the recognizable community names are: Bearden, Campbell's Station, Loveville (Lovell Today), Ebenezer, Ball Camp, Fountain City, Asbury, Corryton, Mascot, Vestal, and Skaggston.

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[197] Ibid., p. 71.

[198] Ibid., pp. 72-73.

[199] Ibid., p. 73.

With Knoxville's slow but steady growth important changes in the physical development of the city were occurring.

> The town was beginning to expand beyond the corporate boundaries which were established by the commissioners at the turn of the century and which were continued in the 1815 city charter. Such expansion was the result of local road improvements.[200]

"In 1819 the Knox County Court appropriated $165 for the first bridge across First Creek at the east end of Knoxville."[201] This bridge was to be used to connect Knoxville with the town of Tazewell. Later, in 1828, the bridge was converted into a small dam with a road constructed atop the levee.

> In 1815, twenty-five years after its founding, Knoxville received its first city charter. The charter was contained in an act of the Tennessee General Assembly passed October 27, 1815, titled "An Act to Incorporate the Town of Knoxville in the County of Knox." The act constituted the town of Knoxville and its inhabitants a "body politic incorporate."[202]

This legislative mandate called for the yearly election of the board of aldermen and mayor. The board of aldermen and the mayor were allowed to pass laws necessary for the town including the determination of the boundaries of streets, lots, and alleys. With these powers, city officials decided to annex more land into the city of Knoxville. This action required state approval.

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[200] Ibid., pp. 73, 75.

[201] Ibid., p. 75.

[202] Ibid.

> . . . the Tennessee General Assembly in 1831 amended the city charter to include within the corporate limits all the land bounded by First Creek, Second Creek, the Tennessee River, and an eastwest expansion of "the street that bounds the Second Presbyterian Church on the North." The northern boundary was undoubtedly Union Avenue since the church was located on the west side of Market Street between Clinch and Union Avenues.[203]

The 1831 annexation continued the application of the gridiron street pattern to the north and west although the blocks were developed in more rectangular configuration. The city's first controversy over road placement occurred in February, 1838, when property owner Matthew Tillery refused to allow a road to go through his land or to receive the damages assessed to him.[204]

> The court ordered, "that said overseer of said road (unnamed) is hereby authorized and directed forthwith with his hands to proceed to open said road by opening any part of Tillery's Enclosure that is necessary. . . . And remove all obstructions out of the way and also to repair the road in any place that is necessary to said premises when said road was Laid out by the Jury appointed to Lay out said road through said farm."[205]

With the incorporation of Knoxville, the city's forefathers not only oversaw the design and placement of streets in the city but their maintenance and improvement as well. This was supported by the state's legislature mandating that:

> All free inhabitants and slaves of the description subject by the laws of Tennessee to work on the public roads (except students in East Tennessee university) were required to work on the streets

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[203] Ibid.

[204] Mary U. Rothrock, op. cit., p. 61.

[205] Ibid.

> four days during each year, or pay seventy-five cents forfeiture for each day's failure. The city was at this time divided into three wards; the first ward being that portion of the city east of State street and extending north to the boundary street of the town, which is now Union Avenue: the second ward included that portion of the town lying between the first ward and Prince street (Market Street), extending north to College street, and the third ward embraced the remainder of the town west of the second ward. Overseers of the streets for each ward were appointed, their duties being the same as those of overseers of highways. An ad valorem tax on real estate was levied and the moneys thus raised on any street were to be expended equally on the contiguous streets. Street commissioners were appointed to disburse the moneys appropriated for the respective streets. The property owners on Main street petitioned the board of aldermen to double their taxes for street improvement![206]

Without a doubt, these taxes and/or physical improvements assisted in emphasizing the development of certain streets within the city of Knoxville. As previously mentioned, property owners on Main Avenue petitioned the board of aldermen to double taxes for street improvement. It is quite likely that because of the taxes and improvements to Main Avenue, the street naturally evolved to become the primary east-west thoroughfare, linking Campbell's Station and communities to the west to settlements developed east of First Creek.

Around 1839, it was thought that Prince Street (now Market Street) would be the principal thoroughfare of the city, and that State Street would be a very important one; but by 1852 Gay Street had captured about 3/4 of the trade, and it was then determined to permanently improve this street.[207] To support the emphasis of these two streets as the primary streets in the city, an ordinance was

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[206]William Rule, Standard History of Knoxville, Tennessee (Chicago, Illinois: The Lewis Publishing Company, 1900), p. 95.

[207]Ibid., p. 96.

passed in 1851 requiring the sidewalks to be eleven feet wide while those on other streets were required to be 4-1/2 feet wide.[208]

> In 1852 Gay street had become the principal street of the town and it was resolved that this street should be macadamized and permanently improved as soon as Main Street was completed to the east side of Gay street, and beginning on the south side of Main street, extending the permanent improvement on Gay street at least as far north side of Cumberland street, a suitable number of hands had to be kept employed in the extension of the Main street improvement to its western terminus.[209]

Despite the improvements made to the city's street system, complaints about road and street conditions continued. "As late as 1849 the board of mayor and aldermen was appointing committees to examine the condition of the streets and report on those that needed widening, opening or altering."[210]

Shortly before the Civil War, Knoxville was able to overcome its problems of isolation by assisting in the construction of the first railroad line in 1855. This development allowed Knoxville to enter its first major period of economic growth. New economic growth meant new construction and development.

> Residential development which had tended to concentrate in the area between First and Second creeks also started to move outward, initially to the north and east. In 1855 a charter amendment pushed the city limits north beyond the East Tennessee and Virginia Railroad. In the following year, East Knoxville became

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[208] Ibid., p. 101.

[209] Ibid., pp. 101-102.

[210] Lucile Deadrick, op. cit., p. 80.

> the first of several cities to grow up adjacent to Knoxville and to be chartered by the Tennessee General Assembly [see Figure 46].[211]

Figure 46 reveals a lot about the subsequent development of Knoxville's street system. First, the layout of the city's first rail lines influenced the design and layout of the street patterns around them. Rail lines from the East Tennessee and Virginia Railroad, East Tennessee and Georgia Railroad, East Tennessee and Kentucky Railroad, Knoxville and Charleston Railroad, and the East Tennessee and North Carolina Railroad all merged together at the present Southern Railway terminal. The congregation of these five rail lines interrupted the gridiron street and pattern north of Summit Hill and actually caused it to angle in a northwestern direction. However, at least the street pattern was designed to be perpendicular with the rail facilities and thus prevented the creation of many funny-shaped lots and street intersections. Other problems also occurred:

> In 1853-54 Gay and Cumberland streets were improved and in 1855 Gay Street was extended north to the railroad depot. Three years later there was a major crisis when the East Tennessee and Virginia Railroad attempted to enclose its property and prevent the passage of wagons and other vehicles on Gay Street through the railroad property. Mayor A.M. Piper called the board of aldermen together to consider what action should be taken. The board decided to write to Nashville for a copy of its charter in relation to the opening, widening, and extended of streets since the 1851-52 amendments to the Knoxville charter directed that Knoxville should follow the same course on such matters as provided in the Nashville charter. In addition it was decided that a committee of three, composed of Mayor Piper and two aldermen, should confer with the railroad to determine what could be done to obtain a right-of-way through the depot grounds ". . . for the

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[211] Ibid., p. 83.

Figure 46. Knoxville in 1855.

Source: Harland Bartholomew and Associates, A Report on A System of Major Streets for Knoxville, Tennessee (Knoxville, Tennessee: City Planning Commission, 1927), p. 2.

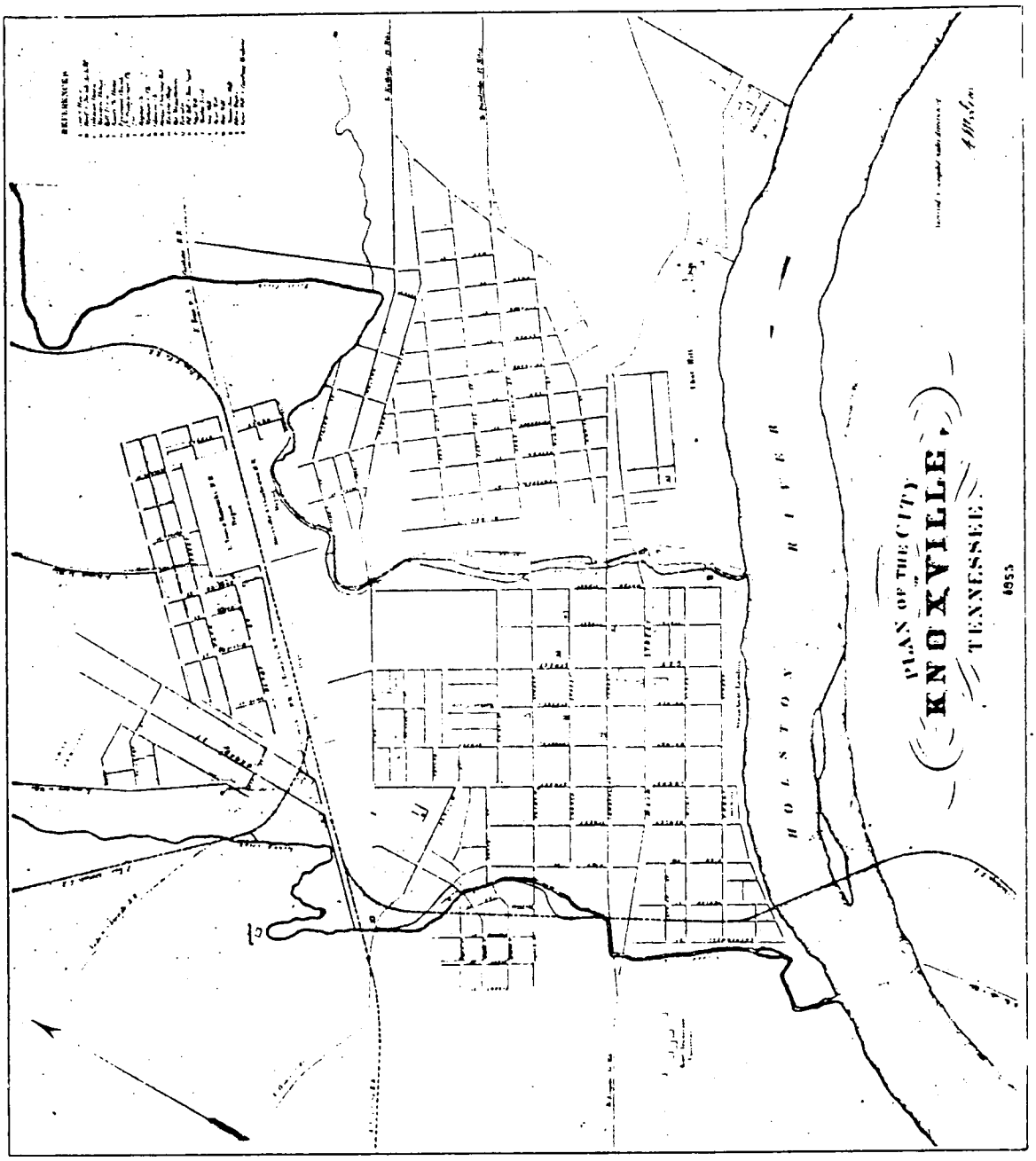


Figure 46

convenience of individuals wishing to pass through said grounds."[212]

To the west of the city was confronted with the same kind of problem it had had with the East Tennessee and Virginia Railroad. In 1860 the board was informed that the East Tennessee and Georgia Railroad intended to close the road on its property in the Second Creek valley. However, the railroad did agree to give the city one half of the right-of-way necessary to make a suitable road from the depot to Second Creek provided the city would furnish the other half. The board accepted the proposal, thus assuring that the city would have access in a westerly direction.[213]

Second, the creation of many new communities adjacent to the city of Knoxville influenced the total street system of the area. For example, as Figure 46 reveals, a substantial gridiron residential community developed in East Knoxville. It appears, however, that the developers of the area were sensible enough to design the street system to comfortably tie-in with Knoxville's established gridiron street pattern. Unfortunately, the gridiron street pattern in East Knoxville was laid upon steep topography, and this made movements in wagons and on foot quite a chore during rainy and snowy weather seasons.

Third, the natural physical constraints of the land, such as the mighty Tennessee River, and First and Second Creeks, also dictated the design and layout of streets and street patterns in Knoxville. It appears that the meandering First Creek stream influenced the creation of an unusual alignment of streets in the northern portion of East Knoxville. Merged with the gridiron street system, a lot of street

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[212]Ibid., pp. 89-90.

[213]Ibid., p. 90.

jogs and acute-angled street intersections were created in East Knoxville.

In the course of this research it was not determined precisely as to why Broad Street (now Broadway) was acutely-angled to the rest of the street pattern north of the railroad depots. It is believed that this street was aligned in such peculiar form in order to parallel the north arrow, possibly to assist in the accurate survey of lands north of the shown development.

Figure 46 also shows the configuration of the many roads which tied into Knoxville. The plan shows the alignment of roads from the Sevierville, Maryville, Rutledge, Dandridge, Tazewell, Clinton, Jacksboro, and Kingston communities. These roads also influenced the street patterns in later growth and development in Knoxville and were very important in the economic growth of the city. Roads to the south required the operation of ferries to transport vehicles and goods to the other side of the Tennessee River.

Through the 1850's, Knoxville's most pressing problem was the alignment and condition of its streets.

> Gay and Prince streets were the most important commercial streets in the town but were reported to be "in such condition as to be a source of shame and mortification." Also, "Main Street from Prince to New Street is in a wretched state and demands attention; Cumberland Street from Crooked Street to the bridge at its eastern end over second creek has been almost impassible and if permitted to remain in its present condition will be literly useless." The streets were not only muddy in the winter but dusty in the summer. In 1856 the board of mayor and aldermen appropriated $2.50 a week toward watering the principal streets during the warm weather or as long as the citizens wanted the streets watered.
>
> The increased importance of Knoxville as a trading center caused a serious traffic problem for the times. In 1850 the board

> adopted an ordinance regulating drays, vans, and wagons used to haul merchandise. . . . The marshall was also directed to arrange market wagons on the west side of Gay Street beginning at Main Street and extending north. Finally in 1853 the board decided to look for a parking lot and ordered the marshall ". . . to ascertain whether or not a lot or lots can be provided for public hitching of horses. . . ."
>
> The first organized and systematic attempt to improve the condition of the streets began in 1850 when the board resolved that it was not in keeping with the interests of the city to spend money in a patchwork of streets and agreed to proceed ". . . to adopt a plan embracing a uniform system of graduating and permanently and gradually improving said streets." This resolution was the result of a proposal by Albert Miller Lea, . . ., to survey the streets and prepare a plan for street improvements.[214]

Mr. Lea's plans for improving the alignment and design of the city's streets focused on the difficult grades created by the city's gridiron street pattern. Lea concentrated on improving the grades along Knoxville's principal streets, Cumberland Avenue, Gay Street, and Main Street, first. Conflicts arose with abutting property owners who protested that the work would take an excessive amount of earth from the already hilly landscape and that the cost of this endeavor would be extremely expensive.

> The board did approve a bond issue of ten thousand dollars which was the first major use of bonds for city improvements. . . . The new board stopped the conflict about Main Street by ordering the street grade to be reduced by only three feet and then graded to the level of Gay and Prince streets where they cross Main.[215]

These were then the major events which affected the design and layout of Knoxville's street system prior to the Civil War.

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[214] Ibid., pp. 88-89.

[215] Ibid., p. 89.

B. AFTER THE CIVIL WAR, 1860-1890

> Despite the fact that Knoxville's development into a city was well underway in 1860, the Civil War is too important an event not to be considered as something of a watershed in the history of the city. In the thirty years or so after the war the modern Knoxville, in many ways the city as we know it today, came into being.[216]

In the years after the Civil War, from 1860 to 1890, Knoxville began to grow in leaps and bounds, both economically and physically. The construction of textile and rolling mills plus the development of railroad lines to nearby marble quarries and coal mines allowed Knoxville to become a center of commerce and industry. This economic prosperity attracted thousands of people to the area, requiring the planning and construction of new residential communities. Knoxville's population nearly doubled between 1860 and 1880, and by 1885 was approximately fifteen thousand.[217]

Knoxville's board of mayor and aldermen decided to take advantage of this growth by annexing one of these new residential communities into the city (see Figure 47).

> East Knoxville . . . became the first of these cities to be consolidated with Knoxville. On December 17, 1868, the Tennessee General Assembly abolished the Corporation of East Knoxville and made Knoxville and East Knoxville one municipal corporation. Before that could be made effective, however, the Knoxville Board of Mayor and Aldermen were required to assume all legal and valid debts of East Knoxville.[218]

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[216] Ibid., pp. 27-28.

[217] Ibid., p. 83.

[218] Ibid., pp. 83-84.

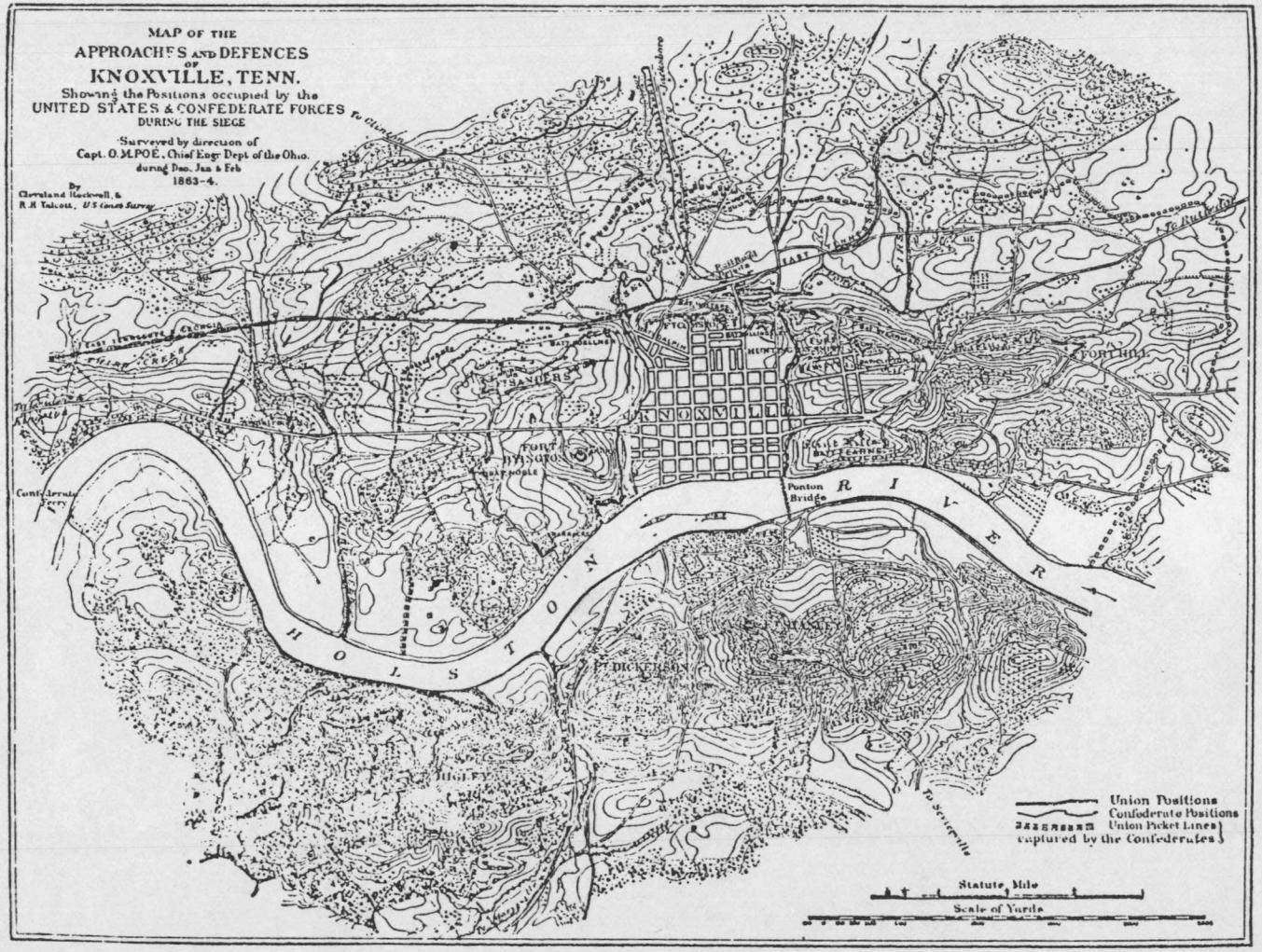


Figure 47. Knoxville in 1863.

Source: Orlando M. Poe, Personal Recollections of the Occupation of East Tennessee and the Defense of Knoxville (Detroit, Michigan: Ostler Printing Company, 1889), p. 1.

This additional territory once more placed the limits of the city in a rough rectangular shape, and meant additional expenditures to bridge First Creek. Also, the gridiron street pattern for East Knoxville was designed to eventually tie into Knoxville's gridiron street pattern. However, First Creek and the steep topography in East Knoxville were obstacles that made travel on the gridiron difficult.

Several other communities also developed adjacent to Knoxville after the Civil War. These towns included Mechanicsville, West Knoxville (now Fort Sanders), and North Knoxville. Each of these cities developed atop hills, laying out streets upon the difficult topography. Despite these known street design troubles, Knoxville decided to expand once again. In 1882, by ordinance under general state enabling legislation, the citizens of Knoxville voted to annex Mechanicsville into the city. The general street pattern for Mechanicsville was a basic gridiron, however, a variety of acute-angled streets and avenues were also constructed in the town. The basic gridiron was platted perpendicular to the established Asylum Avenue (later renamed Western Avenue and Summit Hill Drive) but due to the topographical and property boundary constraints of the area, many other streets were also built to interrupt this pattern.

Growth in South Knoxville became dependent on the ability to cross the Tennessee River. Because of the steep river banks and difficult topography, access to the south typically became an adventure. Ferries provided for crossing the river, however, at the time of the Union occupation of Knoxville, a bridge was built by the military

which was taken over by Knox County in 1866.[219] This bridge was constructed to replace the old Civil War pontoon bridge and align State Street with the bluffs along the south side of the river.

> Thus, by the mid-1860's Knoxville had eliminated the barriers which surrounded the original town site and could now expand in all directions. New streets were added within corporate limits. As the city grew the street committee of the board of mayor and aldermen in 1867 was authorized ". . . to have the names of the principal streets of the city marked at most public corners so that strangers and others might be able to find the steets or to know on what street they were traveling. . . ."[220]

It would appear from the quoted statement above the city of Knoxville was already beginning to feel the effects of the lack of true hierarchy of streets. Problems with the city's rapidly expanding street system did not end there. Knoxville continued to have trouble building a facility to cross the Tennessee River.

The military bridge linking the Central Business District of Knoxville to South Knoxville was swept away by the great Spring flood of 1867. In 1871, a private company replaced the bridge with a new one at the south end of Gay Street. The bridge was built there because Gay Street was the central business street in the city of Knoxville. "It was suggested that more tolls would be derived from the Gay Street location, and the approaches thereto could be constructed as cheaply as those to either of the other streets."[221] "This bridge was

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[219] Ibid., p. 90.

[220] Ibid.

[221] Mary U. Rothrock, op. cit., p. 154.

destroyed by a tornado in 1875 and replaced in 1880, again by a private company."[222] This bridge lasted until the turn of the century.

While the city of Knoxville and Knox County labored for three decades over the proper design and construction of a "permanent" bridge to South Knoxville, they essentially ignored the need to build and/or reconstruct the area's many main roads and turnpikes. Part of this was due to the developing nature of the railroad industry in the area at the time.

The State of Tennessee decided to step in and help this desperate situation. With the county's residents resisting to pay cash levies to improve these roads, the State authorized the creation of turnpike companies to do the work.

> In May 1866 the state chartered six turnpike companies that would serve Knox County. . . . The 1866 legislation also named the commissioners to guide each company, delineated the route to be followed, and set the tolls that could be charged. . . .
> The roads were to be at least twenty feet wide, with fourteen of the twenty feet to be macadamized. . . .[223]

The design and construction of these turnpikes greatly assisted the growth and development of the surrounding towns and unincorporated cities. Each of these pikes provided a focus for developing adjacent street systems in later years.

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[222]Lucile Deadrick, loc. cit.

[223]Ibid., pp. 186-187.

> As a preview of new types of vehicles allowed to use the turnpikes, the legislature in 1879 made it lawful "to propel by steam upon the public highways and macadamized roads, waggons, carts and other vehicles, for the purpose of carrying passengers and for transportation to markets" of any goods lawful to be carried on railroads.[224]

C. AROUND THE TURN-OF-THE-CENTURY, 1890-1915

From 1890 to 1915, Knoxville's street system continued to grow. Much of this new growth was stimulated by the industrial revolution taking place in the United States. The invention and refinement of the manufacture of streetcars and automobiles, the increasing popularity of the use of electricity, and the development of steel frame construction were all products of the industrial revolution which impacted the design and construction of Knoxville's street system, particularly in the suburbs.

With the area between First and Second Creeks becoming more and more the commercial center of Knoxville, residential development moved outward. This expansion was assisted by the development of a network of electric streetcar lines through the city. An editorial in the February 27, 1907, issue of the Knoxville Sentinel newspaper must have reflected the point of view of most Knoxvillians:

> Knoxville is not alone in its campaign of suburban development. Progressive cities over the south are "stretching out" so to speak. The congested "uptown" districts are being outgrown for residential purposes, and the outskirts are being transformed from old fields into palatial residential sections. This has been made

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[224]Mary U. Rothrock, op. cit., p. 238.

possible largely through the instrumentality of electric railway systems.[225]

Electric streetcar service was introduced to Knoxville in 1890. Significant growth and development occurred along the extension of four of these routes, McCalla Avenue, Burlington, Washington Avenue, and Broadway, in 1892.[226] Each of these routes influenced the planning and design of the street systems in these suburban areas. A gridiron street pattern was developed adjacent to each of these streetcar lines because it was technically much easier to construct a streetcar line in a straight line than one with multiple curves and angles. Developers of these areas also liked the gridiron street pattern because less money would have to be put into the construction of the streetcar line.

While the electric streetcar played a major role in the planning and design of Knoxville's suburban street systems, it should not be forgotten that the city's most famous and influencing streetcar lined was powered by steam. In 1890, the Fountain Head Railroad Company built the infamous "Dummy Line" to connect Knoxville with the new resort of Fountain Head (later to be called Fountain City). All trains left Knoxville from the junction of Broadway and Tyson Street and traveled through the gridded streets of Lincoln Park and North Knoxville. From there the Dummy Line followed the easiest path to Fountain Head, winding along First Creek and an old country road to

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[225]Lucile Deadrick, op. cit., p. 100.

[226]Ibid., p. 101.

Whittle Springs. The route snaked through Sharp's Ridge and along the rolling hills north to the resort community (see Figure 48). From approximately Atlantic Avenue in Lincoln Park north to Fountain Head, the Dummy Line's layout and configuration dictated the street patterns that were developed adjacent to this line. Almost all of the street that were constructed next to the old Dummy Line were designed in a gridiron pattern. This was done primarily to aid in the subdivision and marketing of the new suburban lots. Later, in 1905, when the steam railway was replaced with an electric streetcar line, the railroad right-of-way became open for public use. This right-of-way became three principal streets in North Knoxville: Huron Street, Walker Boulevard, and the northern portion of Broadway.

Knoxville's desire to expand once more came in April, 1897, when the state's general assembly passed a bill consolidating Knoxville with the towns of West Knoxville and North Knoxville. "The bill provided that an election was to be held on the same day in all three communities to determine the wishes of the people."[227] The elections were held on July 23, 1897, and the people decided to accept the consolidation proposals. With this vote, the size of Knoxville's corporate city limit doubled. As a result, Knoxville inherited some of the most poorly designed streets that could be found in the city. Much of this can be traced to the fact that West Knoxville's and North Knoxville's residential neighborhoods were built in piecemeal fashion, creating many unusual-angled streets and intersections, and street jogs (see Figure 49).

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[227] Ibid., p. 104.

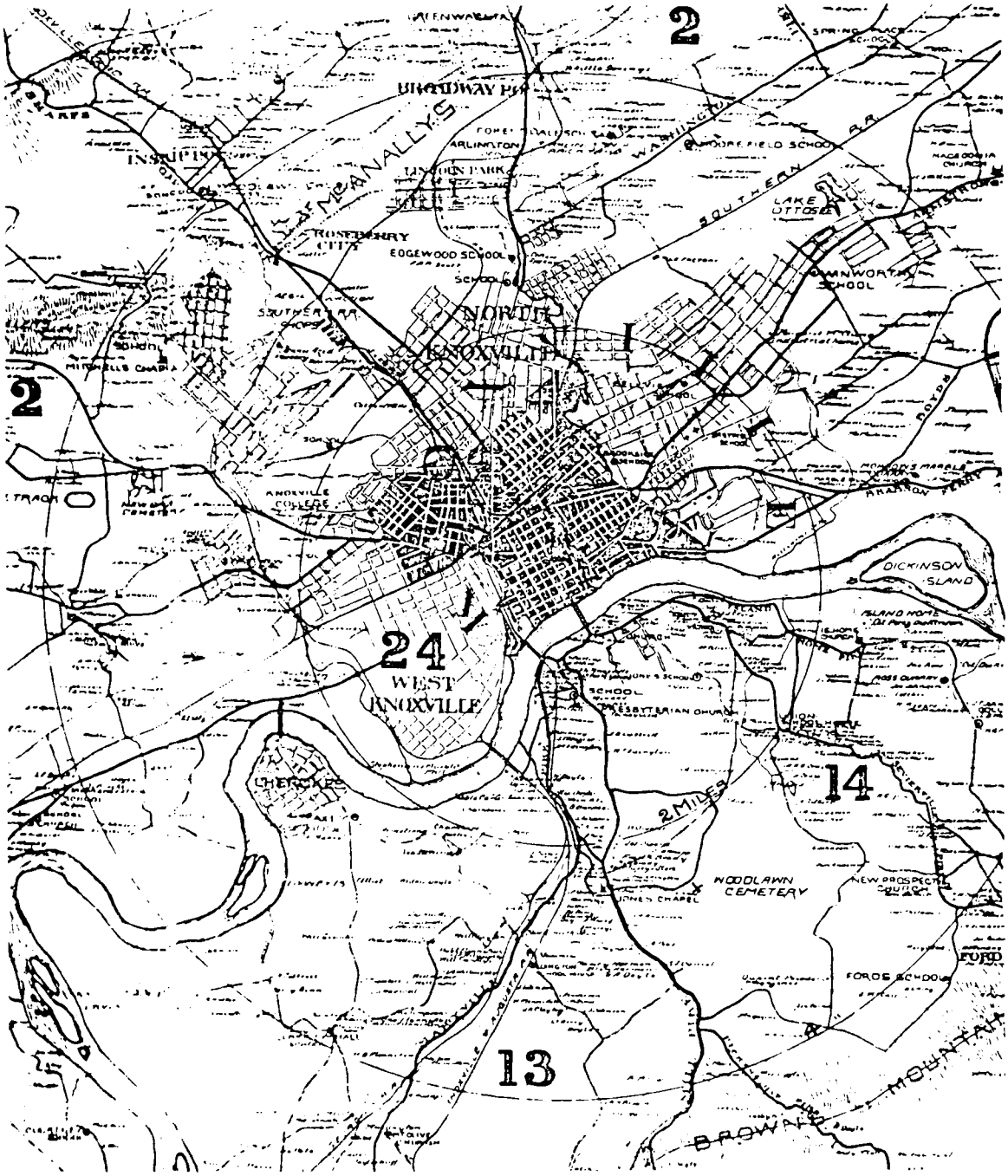


Figure 48. Knoxville in 1895.

Source: Vance, Coffee and Pill, Map of Knox County, 1895.

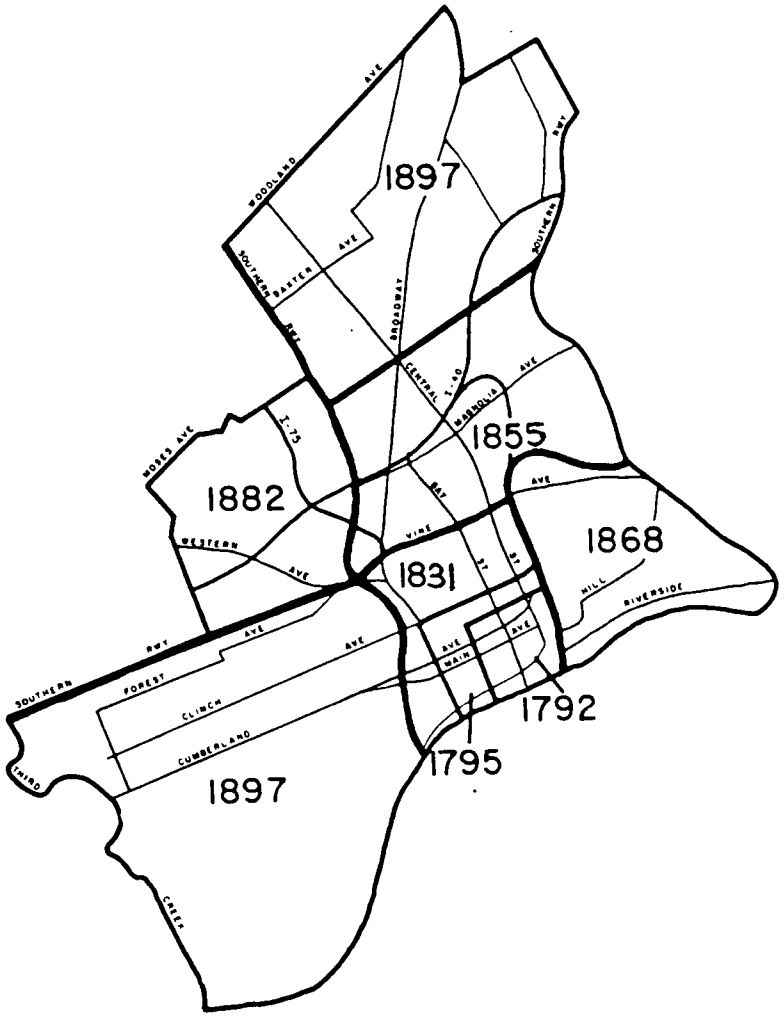


Figure 49. Growth of Knoxville Before 1900.

Source: Lucile Deadrick, Heart of the Valley, A History of Knoxville, Tennessee (Knoxville, Tennessee: East Tennessee Historical Society's Publications, 1976), p. 80.

During this same period of time, Knoxville's forefathers became interested in replacing the slowly decaying wooden Gay Street bridge with a more substantial and wider steel bridge across the Tennessee River. In 1895, the County Court contacted the Tennessee Legislature, urging the passage of an act permitting the County to issue $225,000 of bonds for the construction of the new bridge.[228]

> A committee was also set up to investigate the state of repair of the existing bridge and the need for a new one. This committee reported that the old bridge had only three or four years of life in it and recommended that the County endeavor to have Congress pass an Act permitting the construction of a new bridge upon the present piers.[229]

A resolution to receive bids for the construction of the new steel edifice was overwhelmingly passed by the County Court. The resolution provided a vivid picture of the situation:

> . . . the time has arrived when it is an absolute necessity to build a bridge across the Tennessee River a Knoxville, to take the place of the present old bridge across said River at Said city. . . . Being, as it is situated at the South end of Gay Street, and being part and parcel of said Street, and being only fifteen feet wide, with no walkway, it, in consequence of the increase travel, traffic and trade, has become dangerous, to the lives of people who are, by reason of their business, compelled to travel across said bridge, and especially is it dangerous for those who travel over said bridge on foot. Meeting as they do every day, wagons, drays, carriages, buggies, horsemen and more particularly is it dangerous because of cattle, Hogs, Sheep, etc. which are driven . . . daily across said bridge for the purpose of meeting the demand of slaughtering, packing, etc. Stock yards, slaughter pens and packing houses of large dimensions have been established on the South side of said bridge. . . . The grade on the approaches to said bridge is so great or steep that it is

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[228]Mary U. Rothrock, op. cit., p. 163.

[229]Ibid.

> almost impossible for teams to pull anything like a load. Often teams are doubled on the grade of the City side of the bridge, in order that a load may be pulled up this grade which has hauled over our County-Pikes with one team of horses. . . .[230]

The new Gay Street bridge was completed on July 9, 1898. "Prior to the formal opening the Court had granted a right of way to the Knoxville Traction Company and to the Knoxville Electric Light and Power Company to run electric cars over the new County bridge."[231]

> These grants were typical of many which had been made to different railway . . . companies since 1885 for use of county pikes and roads, and mark the beginning of the urge for expansion and development which was so evident after 1900.[232]

> This was also a time when major public improvements were made. Some of these improvements are today important to the functioning of the city. For example, the concept of the viaducts and bridges leading out of the business district was developed and many were built during this period. Several were built in 1935-37: Fifth Avenue, 1892, rebuilt 1936; Oak Street, 1893, rebuilt 1935; Hill Avenue, 1892, rebuilt 1936; Church Street, 1892, rebuilt 1937; Clinch Avenue 1905; . . . and Western Avenue (Asylum Street), 1909.[233]

As the reader will notice, each of the aforementioned bridges and viaducts were built to provide direct connection over large railroad rights-of-way, creeks and streams, and the many valleys in which Knoxville was platted.

Knoxville, like every other city in the United States at the

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[230] Ibid.

[231] Ibid., p. 164.

[232] Ibid.

[233] Lucile Deadrick, op. cit., p. 108.

turn of the century, became fascinated with a new invention called the automobile. Mary U. Rothrock, author of the book The French Broad-Holston Country, noted the immediate impact of the invention of the automobile on the County Court's resolution to the federal government to build a national road through Knoxville and Knox County.

> Into this placid world, the automobile was to bring the virus of unrest. Its influence was felt as early as 1901, when on October 8 of that year, the County Court adopted a most remarkable resolution. It urged the National Government to spend $50,000,000 for a national highway from New York to New Orleans, by way of Washington; to be ". . . 100 feet wide; 20 feet each way for automobiles, 20 feet each way for wagons and carriages; 5 feet each way for bicycles, and 5 feet each way for footmen. . . ." It was to be paved with asphalt, be lighted with electricity, and have a water main along its full course. It was to run through the main valley of East Tennessee and pass within a mile of Knoxvile, "but in no other instance to swerve from its line of directness in order to go through any other town." . . . common roads are important, it said ". . . the bicycle and automobile interests of the country imperatively demand that something in the way of public roads be done . . . we will never have a good cross-continent road as long as their construction is entrusted to individual Courts or States."[234]

Although Knoxville and Knox County had begun to dream dreams, it was to enjoy another decade and a half of comparative repose before succumbing to the automobile age. The effects of a poorly planned system of streets and roads in Knoxville and Knox County were not fully visible until the 1920's when congestion became the order of the day. Local concern was directed toward the surface condition of the streets and pikes and not toward the alignment and configuration of these facilities in mass.

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[234]Mary U. Rothrock, op. cit., p. 168.

D. AFTER WORLD WAR I, 1915-1940

Between 1915 and 1940, Knoxville witnessed another period of significant population growth and physical expansion. Despite the calamitous effects of World War I and the Depression, the city's population tripled from approximately 37,000 in 1915 to 111,580 in 1940.[235] "The rapid rate of population increase, coupled with the less dense pattern of development in the 'streetcar suburbs,' resulted in a large territorial expansion in 1917" (see Figure 50).[236]

> . . . the city annexed the four previously incorporated towns of Lonsdale, Mountain View, Park City and Oakwood, as well as large unincorporated areas such as South Knoxville and Sequoyah Hills. The land area of the city was thus increased from four to twenty-six square miles. The census of 1920 reflected this dramatic growth in figures which showed that the city's population had more than doubled in ten years. Knoxville was described as the "One Hundred and Fourteen Per Cent City" in promotional literature which made the most of this tremendous growth rate.[237]

Of course, Knoxville did not continue to grow at a 114 percent rate but the effects of this growth and expansion were harmful to the overall street pattern of Knoxville. Development in the areas between most of the annexed cities resulted in an ad-hoc, unplanned street pattern. It is in these transition areas where most of the serious street design troubles were found. With the ever-increasing popularity of the automobile, the defects in the city's street system

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[235] Lucile Deadrick, op. cit., p. 74.

[236] Ibid., p. 109.

[237] Ibid., pp. 50-51.

Figure 50. Annexations and Undeveloped Areas.

Source: Harland Bartholomew and Associates, A Report on A System of Major Streets for Knoxville, Tennessee (Knoxville, Tennessee: City Planning Commission, 1927), p. 12.

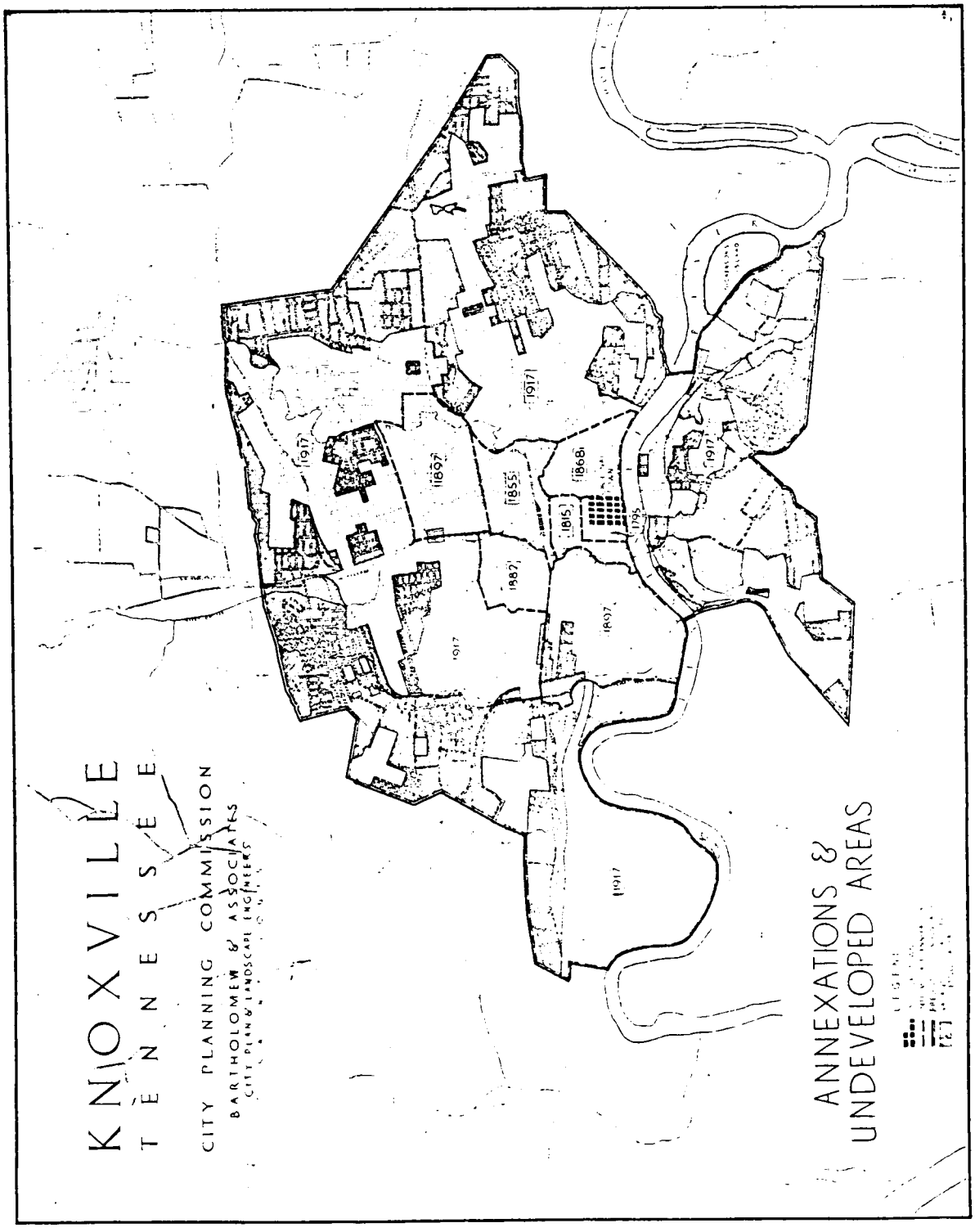

KNOXVILLE
TENNESSEE
CITY PLANNING COMMISSION
BARTHOLOMEW & ASSOCIATES
CITY PLAN & LANDSCAPE ENGINEERS
1917
1897
1855
1868
1815
1795
1887
ANNEXATIONS &
UNDEVELOPED AREAS

Figure 50

became noticeable. In 1939, a University of Tennessee student named Victor Albert Hyde made this observation of Knoxville's growing street pattern in this thesis, "A Geographical Survey of Knoxville, Tennessee:"

> The street pattern of the city of Knoxville is one of a heterogeneous nature of the result of the incorporation of satellite communities to form the present city. With each additional area taken into the city, correlation of streets has been extremely difficult. Physical features often necessitated the "jogging" of streets to avoid steep gradients; and the presence of stream valleys often determined the main routes.
>
> The street system is definitely characterized by a lack of one central pattern. Instead, the city has approximately eleven different sections about which the streets focus. In the regions comprising areas taken into the city in 1917 there has been an attempt at planning, but in the older and more highly developed portions, the streets are the same as in former days.[238]

Lucile Deadrick provides a clue as to why Knoxville's street system developed similar to earlier annexations.

> The ridges and valleys of Knoxville's topography were a major force in shaping the pattern of development. The steep, narrow slopes limited the spread of urban development, forming buffers between different parts of the community. Like the ridge lines, the Holston and French Broad rivers converging east of Knoxville to form the Tennessee River played a major role in shaping the city. Within the limits of its natural features, Knoxville was shaped by man.[239]

Probably the most interesting street pattern annexed into the city of Knoxville in 1917 occurred in the Sequoyah Hills subdivision. By not using traditional subdivision patterns, Sequoyah Hills featured

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[238]Victor Albert Hyde, "A Geographical Survey of Knoxville, Tennessee" (Thesis, University of Tennessee, August 1939), p. 46.

[239]Lucile Deadrick, op. cit., p. 111.

extra large lots accessed by a curvilinear, topography-sensitive street system. The winding boulevards were designed to prohibit traffic from obtaining high speeds while following the meandering course of the Tennessee River. The subdivision was an exception when it was built and is still considered the prime place to live in Knoxville.

While the City of Knoxville was trying to figure out how to provide services for the newly annexed portions of the city, Knox County officials became interested in developing new high speed highways for the increasingly popular automobile. In 1911, Knox County joined the Knox County Good Roads and Parks Association in applying to the Office of Public Roads of the United States Department of Agriculture for an engineer to survey the best route from the Grainger County line in Knoxville as a part of Knoxville to Bristol road.[240] "And in 1919, the County took a limited step forward when the Court voted $150,000 in bonds for a Maryville-Mascot road, a project which involved the cooperation with another county."[241] However, the project was not completed for about eight years and was apparently finished with state assistance.[242] This road became the predecessor to the present Maryville Pike.

> The first observed State and Federal road building project in which the County participated, was that to rebuild the Kingston Pike with a hard surface from the city limits to the Loudon County

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[240] Mary U. Rothrock, op. cit., p. 178.

[241] Ibid.

[242] Ibid.

line. Cooperation was voted by the County in October, 1920 and the obligation of $100,000, which it assumed, was one-third of the anticipated cost.[243]

With the increasing number and importance of good roads, Knox County began to think beyond its own boundaries. On January 5, 1925, Knox County Court adopted a resolution ordering ferry operators to notify the Knoxville Automobile Club when a ferry was inoperative, the Club to bear the cost of the message. This was followed in July of the same year by a flowery resolution in which the Court petitioned to build a boulevard from the city of Knoxville to the western gateway of the Great Smoky Mountain National Park. This boulevard was built in tribute to Colonel David C. Chapman, the founder of the Great Smoky Mountain National Park, was officially called Chapman Highway.[244]

By 1930, with the help of the Federal Highway Act of 1921, Knoxville was connected by paved roads with other major cities in all directions. U.S. Primary highways serving the area were route 11 to Chattanooga and Bristol (11-E and 11-W east of Knoxville); route 25-W to Lexington, Kentucky, and Cincinnati, Ohio; route 70 to Nashville and Asheville, North Carolina; and route 120 to Maryville and Atlanta (via route 411 south of Maryville).[245] Certain state-numbered highways also were eligible for federal aid under the 1921 Federal Highway Act and during the Depression federal funding was extended to

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[243]Ibid., p. 179.

[244]Ibid.

[245]Lucile Deadrick, op. cit., p. 188.

secondary roads and city streets.[246] Most of these improved state and federal highways were designated along the major pikes which radiated out from the city of Knoxville. These official designations and improvements to the pikes assisted in the economic development of the city, before and after the Depression, but also focused much of the traffic congestion in the Central Business District of Knoxville.

In recognition of the ever-increasing traffic congestion in the city, the Knoxville City Council adopted an ordinance officially establishing the city's first arterial streets. The ordinance, passed in 1924, called for the following streets to be designated as "Through Traffic Streets": 1) Magnolia Avenue east from Gay Street, 2) Broadway north from Southern Railway, 3) Central Avenue north from Fifth Avenue, and 4) Cumberland Avenue west from Gay Street.[247] Not surprisingly, the city's official proclamation of these routes as "Through Traffic Streets" paralleled the state and federal government's official designation of these streets as state and federal highways.

> During the twenties a change began to take place in philosophy about local governments' duty to provide services to residents. The minimum services to maintain law and order and provide essential capital improvements were no longer enough. A system of parks without the provision of organized recreation programs now seemed inadequate. Sciences devoted to managing urban development were coming into being. Formal planning for the city's growth, systematic programming of capital improvements, and codes to

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[246] Ibid.

[247] City of Knoxville, Ordinance Regulating the Use of Streets, Alleys and Public Places in the City of Knoxville (Knoxville, Tennessee: City Council, September 30, 1924), p. 18.

> regulate building, were desired by the same Knoxvillians who wanted the efficient city manager form of government to replace the commission form.[248]

In 1925, Knoxville joined thousands of other cities and towns across the nation in establishing an advisory board to plan for the physical and economic growth of the city. One of the first tasks of Knoxville's city planning commission was to contract with a firm of city planning consultants to prepare a comprehensive city plan.

Harland Bartholomew and Associates of St. Louis, Missouri, was selected to prepare the city's first comprehensive plan. Realizing the city's acute problems with the design of its street system, the firm's first report to the planning commission provided an incredibly detailed analysis of the system's deficiencies, and a series of far-reaching recommendations to solve the city's street design problems. Entitled A Report on a System of Major Streets for Knoxville, Tennessee, this thoroughfare plan was adopted by an ordinance of city council on September 27, 1927. It was and still is a remarkably informative piece of work. Below is a detailed discussion of the report's insightful findings and recommendations.

The Introduction of the report described the need for street planning in Knoxville:

> The fact that Knoxville has never had an official plan is recognized today. The city has allowed itself to get into a rather bad condition. This is due to a number of causes, which will be discussed more fully in following pages. In the first place, Knoxville is old. Certain parts of the city have an age

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[248]Lucile Deadrick, op. cit., pp. 116-117.

> passing a hundred years. Secondly, the city is built upon ground that called for especially flexible and sympathetic treatment in the early days. The form and character of the city today show that this was rarely applied. Finally, the general lack of interest in problems of municipal development and absence of a belief in the city's future led to mistakes and errors of policy which have caused later trouble.
>
> A few of the general shortcomings and weaknesses of Knoxville may be noted merely to indicate faintly the handicaps under which it carries on its daily business.
>
> The street system of the principal business center is poorly adapted to motor circulation and will suffer increasingly until relief is found. . . .
>
> . . . . . .
>
> Whether Knoxville corrects past mistakes or not, it can prevent them in the future. The things that have happened show clearly what to avoid--and also in many cases what to do again. The city plan will be an appraisal of the present Knoxville to discover the most appropriate form of growth to encourage in future years. . . .
>
> . . . . . .
>
> No general prescription for a growing city can remain valid for all time. Changing conditions require constant observations and records and frequent modifications of plans. The major street plan is designed to have a certain helpful flexibility about it. But that flexibility is not to be interpreted as looseness or uncertainty. This plan, like those which will follow, has precedent and principle behind it, and these should not be violated by whimsical changes. It is one of the primary obligations of the Planning Commission to avoid mistakes of this sort.[249]

In their discussions of the topographic characteristics of Knoxville, Harland Bartholomew and Associates revealed the difficulties of laying out a street system in an area with such diverse relief features:

> Rugged topography always and everywhere is a handicap to ordinary city building operations. It is extremely difficult, for instance, to devise a scheme of streets which will satisfy the circulation requirements of the community, and yet nicely fit the hills and valleys. Few cities that just grow in such terrain, especially in this country, show much adaptability. They lack the

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[249]Harland Bartholomew and Associates, op. cit., p. 7.

> individuality which such a site would seem to favor. They are full of common stupidities: streets with grades so steep they cannot be used, . . . streetcar lines winding about to avoid slopes. . . . Such conditions develop where creative intelligence has not been applied to ordinary civic improvement matters. The regulations, formulas and practices which produce a fairly satisfactory town on the plat do not work in country like that around Knoxville. And yet, men continue to try to make them work, despite the multiplied evidence of failure around them.
>
> The map [not shown due to poor reproduction quality] gives a fair picture of the ground upon which Knoxville has been laid out and upon which it is expanding. The peculiarities of street layout may be seen. The abnormal grades may be surmised. The microscopic park areas of the city have been especially marked to show the extent to which the city has gone in neglecting natural park features, in endeavoring against economic laws to convert these resources into conventional square city blocks and commonplace streets. . . .
>
> . . . . . .
>
> All that has been said above leads merely to the statement that the city plan must enforce a more careful regard for natural slopes. There is no sense continuing to plat streets that cannot serve their purpose. A new street planning technique is requried for use under certain conditions. The pattern of the city must be laid with general artistry over the rugged terrain of the site. The economy of determining appropriate uses of land before city growth takes place must be considered.[250]

In analyzing the history of Knoxville's growth pattern, Harland Bartholomew and Associates described the importance of planning the street system in an area which is largely undeveloped.

> A very large area of undeveloped land exists on the outskirts of the city. The proper development of these areas in the future may be brought about by applying the principles of city planning. The various steps in this development occur in logical order. It is first necessary to provide streets of adequate width, based on the major street plan.[251]

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[250] Ibid., p. 11.

[251] Ibid., p. 13.

Harland Bartholomew and Associates also described the importance of understanding the significant relationship between land use and transportation in Knoxville.

> In considering the relationship of traffic circulation and the use of land, it is necessary that the principal objectives of traffic movements be determined and kept in mind. In Knoxville, practically all traffic has an objective, the central business district with the industrial sections, schools, etc., as secondary objectives. It is very important for the well-being of the city that means be provided for full interchange of traffic between different objectives. For example, ample streets should connect all industrial districts with the railroad terminals. Adequate entries should be provided to the business district. Connecting streets affording easy connection between the different residence districts should be provided. . . .
>
> . . . . . .
>
> In planning the future of the city, the location of the various land uses will be determined by the major street plan and the zoning ordinance.[252]

After analyzing the basic physical characteristics of the Knoxville area, Harland Bartholomew and Associates began to look at the physical characteristics and problems of the city's street system.

> The inadequacy of the street system is shown by the street width map [see Figure 51], showing streets 60 feet or more in width. There are surprisingly few wide streets, and some of the streets that meet the requirements of width are so situated that full advantage cannot be taken of them by traffic. Magnolia Avenue is an excellent thoroughfare for a portion of its length, but unfortunately the street narrows down near the business district and terminates at Sterchi Park.
>
> University Avenue is a 100-foot street for part of its length, but was no outlet and terminates abruptly against a railroad embankment.
>
> Painter Avenue, Temple Street and Island Home Boulevard are wide streets, but they do not fit into the traffic circulation scheme. Many of the older streets are but from thirty to forty feet in width, some of them being required to carry a heavy traffic. Kingston Pike, for example, is but thirty feet in width.

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[252] Ibid., p. 23.

Figure 51. Present Street Widths.

Source: Harland Bartholomew and Associates, A Report on A System of Major Streets for Knoxville, Tennessee (Knoxville, Tennessee: City Planning Commission, 1927), p. 24.

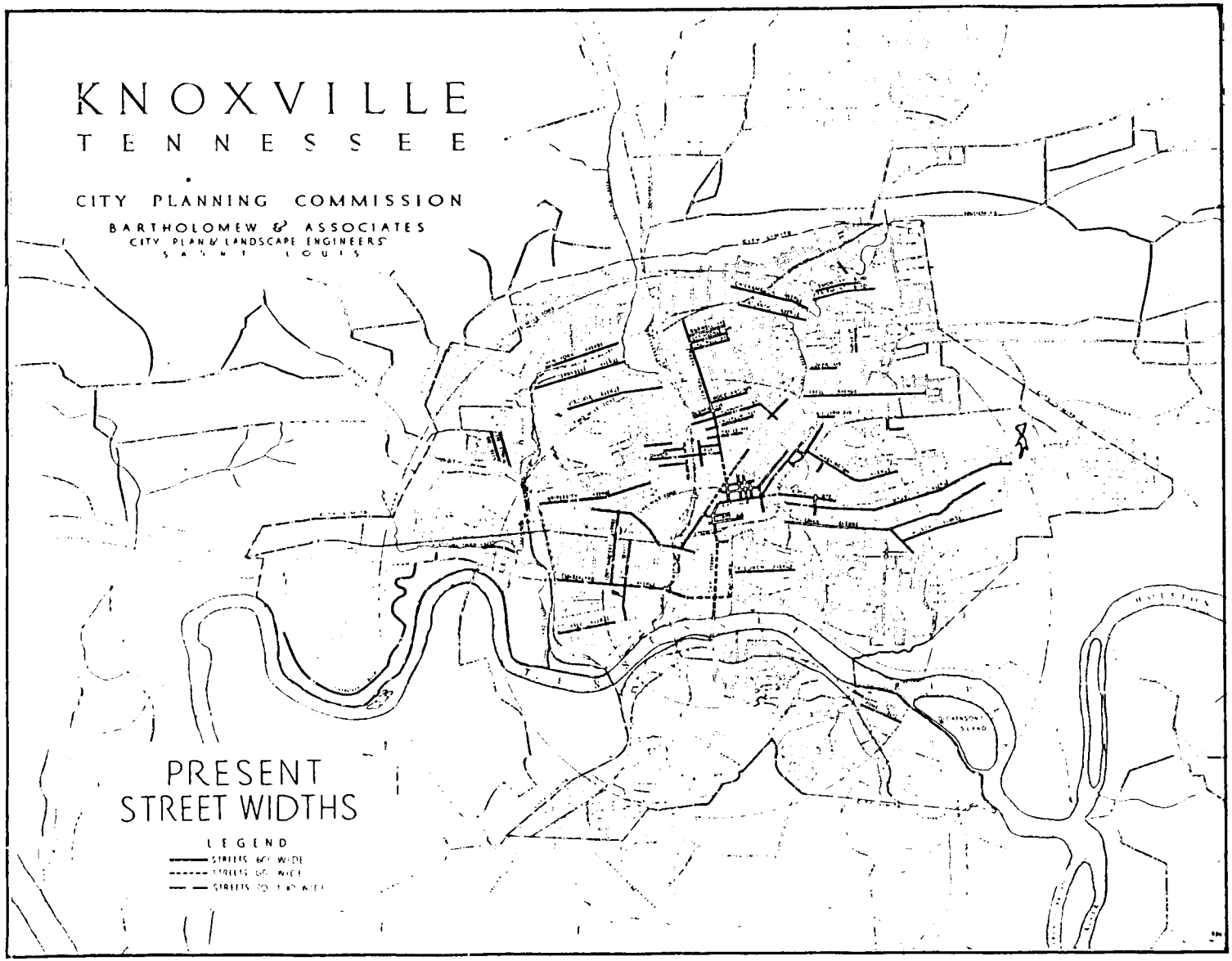

KNOXVILLE
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BARTHOLOMEW & ASSOCIATES
CITY PLAN & LANDSCAPE ENGINEERS
SAINT LOUIS
PRESENT
STREET WIDTHS
LEGEND

Figure 51

> The radial streets originally the old pikes offer means of access to the business district by comparatively direct routes, but inadequate width lowers the capacity of these streets to a serious degree.
>
> The haphazard and unsystematic street layout is the result of past lack of interest in the city's problems of growth. Land subdividers laid out their streets according to their own ideas and did not realize that they were building the framework of a city. These men were not entirely to blame for their actions, as the city had no plan to guide them.[253]

Probably the most telling chapter of Harland Bartholomew and Associates' study of Knoxville's street system occurred in their analysis of "Paved Streets, Jogs and Dead Ends."

> Some serious results of uncontrolled subdividing are also indicated on this plate [see Figure 52]. The prevalence of jogs and dead ends is clearly shown. Each one of these is an obstacle to free-flowing traffic, and in the aggregate constitute a serious handicap to proper city growth.
>
> It is the purpose of this plate to convey the seriousness of traffic circulation disturbance by jogs and dead ends taken in the aggregate. Many of these obstacles to traffic flow could have been eliminated by proper land platting, while others are due to the obstruction of parks, cemeteries, etc., through which streets could not be extended. Granted that certain of these jogs and dead ends could not be avoided, nevertheless they constitute an interference to traffic movement.
>
> The economic loss in traffic delays caused by these impediments is tremendous. Their elimination upon major streets is, of course, necessary and often expensive, but the city should, by proceeding in a logical and systematic manner, spread this expense over a number of years, so that the annual cost will be comparatively small. Many jogs which are comparatively unimportant at this time can be eliminated at slight cost. Such action taken in the near future would accomplish a large saving over the expense of doing the work when developments have taken place in future years.
>
> The elimination of the bad turn at the intersection of Atlantic Avenue and Central Street is an example of such an improvement that can be done at very little expense to the city. The elimination of the jog at Atlantic Avenue and Felts Street has been provided for already by the city's acquiring the necessary land for

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[253] Ibid., p. 25.

Figure 52. Paved Streets, Jogs and Dead Ends.

Source: Harland Bartholomew and Associates, A Report on A System of Major Streets for Knoxville, Tennessee (Knoxville, Tennessee: City Planning Commission, 1927), p. 26.

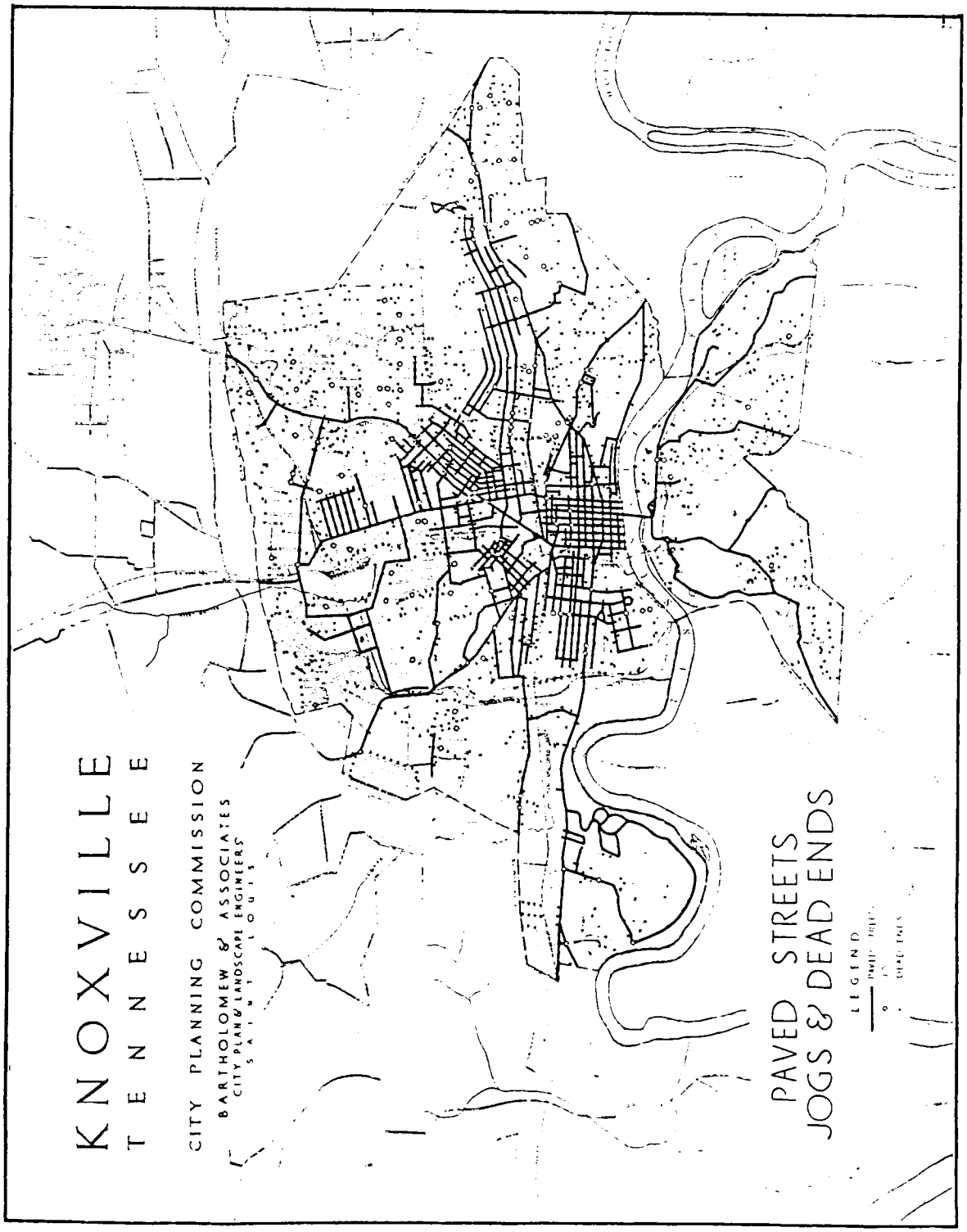

KNOXVILLE
TENNESSEE
CITY PLANNING COMMISSION
BARTHOLOMEW & ASSOCIATES
CITY PLAN & LANDSCAPE ENGINEERS
PAVED STREETS
JOGS & DEAD ENDS
LEGEND

Figure 52

> the improvement. A little study will show many other places where such improvements could be done at a surprisingly low cost.
>
> There is much outlying territory now in the process of development. The prevention of past mistakes will require the heavy co-operation between subdividers and the City Planning Commission. The importance of this work cannot be over-emphasized.[254]

In examining Figure 52, it was discovered that Harland Bartholomew and Associates had found several hundred jogged and dead-end streets within the city limits of Knoxville. It is believed that this map only shows the "major" jogged and dead-end streets within the city and not the actual total number of jogged and dead-end streets. Of course, not all of the dead-end streets or cul-de-sacs shown on Figure 52 were detrimental to the overall street design pattern and traffic flow in the city. However, there was very little excuse for the establishment of jogged streets within the city despite the firm's contention that some of these maladies could not be avoided.

Harland Bartholomew and Associates through study of Knoxville's street system also included a detailed analysis of the conditions of the streets within the Central Business District (CBD) (see Figure 53).

> The plate opposite gives an idea of the handicap under which traffic circulates in the business district. Steep grades are seen to be numerous. The effect of these grades upon traffic circulation and business conditions is pronounced.
>
> Traffic avoids streets with heavy grades and uses the more desirable thoroughfares. As a result the traffic flow is unevenly

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[254] Ibid., p. 27.

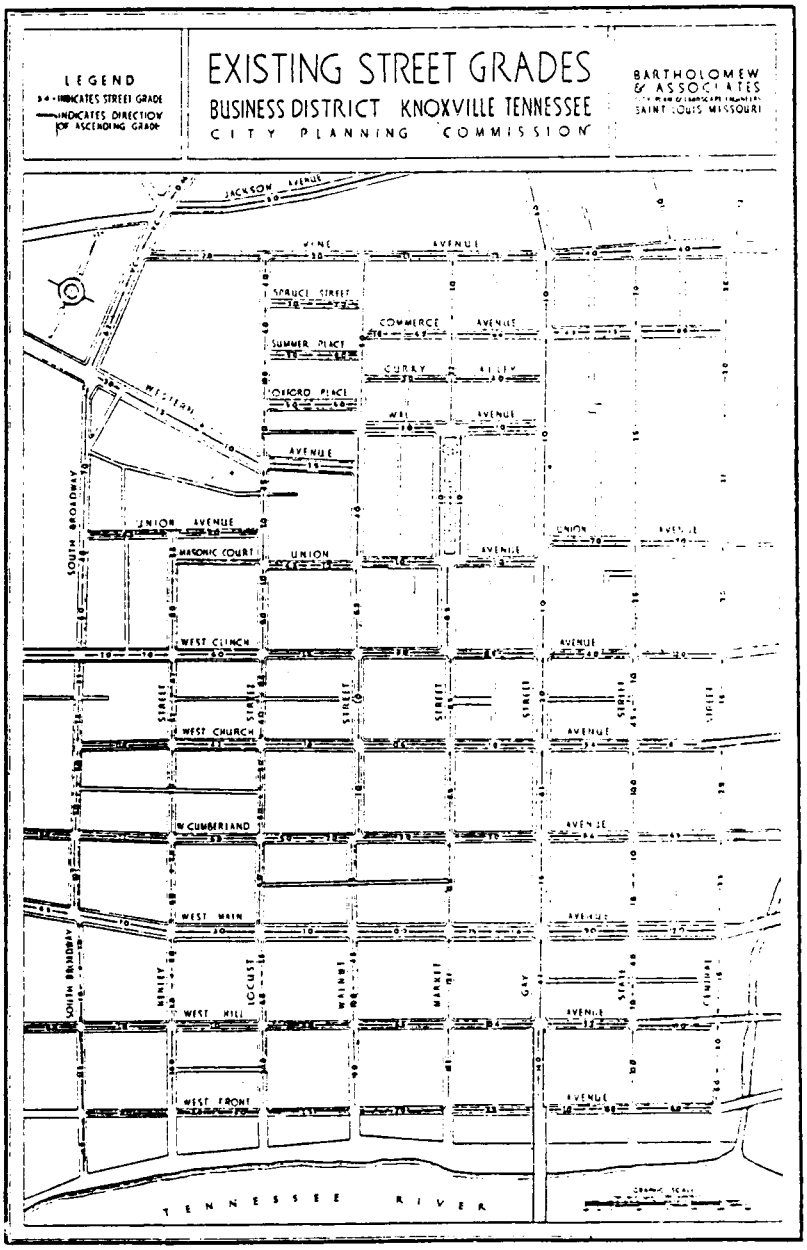


Figure 53. Existing Street Grades.

Source: Harland Bartholomew and Associates, A Report on A System of Major Streets for Knoxville, Tennessee (Knoxville, Tennessee: City Planning Commission, 1927), p. 34.

> distributed, certain streets carrying more than their share and certain other streets being little used.
>
> Practically all traffic entering the business district from the north traverses Gay Street. Central Street parallels Gay Street, but is avoided by traffic mainly because of the steep grades connecting the street with the main business center. Traffic from the east uses Vine Avenue, Jackson Avenue, Church Avenue and Hill Avenue almost exclusively because of the good grades as compared to Main Avenue, Clinch Avenue and Cumberland Avenue. The latter streets offer more adequate width and more direct connections to the business center, but possess grades which discourage their use. Vine Avenue, between Gay and Broadway, is adequately situated to serve as a cross-town street for east and west traffic. However, the street is useless because of its extreme grades. Lacking such a street, the city must go to a great expense in providing such a necessary link in its traffic circulatory system.[255]

Figure 53 shows the preponderance of streets in the CBD with excessively steep grades. The highest figure shown is an incredible 21.5 percent, South Broadway between West Hill and West Front Streets. A number of other streets are also shown in the plan which have double-digit grades. Also, Figure 53 shows at least seven different street jogs within the Central Business District, particularly in the northwest corner of the map.

Prior to their discussion of the major street plan, Harland Bartholomew and Associates provided a brief analysis of radial arterial streets in the city of Knoxville. Below are highlights of that discussion.

> Traffic movement in the city is not an aimless wandering about. Vehicles moving upon the streets are going somewhere. The flow is toward objectives. . . .
>
> . . . . . .
>
> The principal business district is obviously the dominant center. A large portion of the daily flow of traffic within and

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[255] Ibid., p. 35.

without the city is headed toward or leaving this intensively used section. The major street plan must be designed to favor this essential function of the urban body. Proper circulation to and from the heart of the city is a primary requirement of community health. . . .

. . . . . .

If it were not for topographical difficulties, the ideal plan of regional arterial traffic ways would take the form of a spider web. As far as possible this sort of pattern should be worked toward in the development of the major circulation system [see Figures 54 and 55]. . . .

. . . . . .

There is no warrant for the assumption that the congestion of narrow streets and roads will pass away or that the problems of faulty circulation will solve themselves. Public officials are obliged to find a way to relieve distress and prevent recurrence of its causes. The first streets that deserve consideration are the radial route. These are as follows:

Broadway
Central Street
Cumberland Avenue
Sutherland Avenue
Sevier Avenue
Martin Mill Pike
Island Home Pike
Washington Pike
McCalla Avenue
Magnolia Avenue
Western Avenue.[256]

The final section of Harland Bartholomew and Associates' brilliant study of Knoxville's street system was the "Major Street Plan." Within this section were some of the most important recommendations which have affected the overall street pattern for Knoxville. Prior to the description of the "Details of Street Improvements" was an extensive overview of the total plan.

A major street plan is a main line traffic-way, a heavy duty thoroughfare. In addition to local needs it serves the city at large, whereas a local or minor street exists primarily for

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[256]Ibid., p. 39.

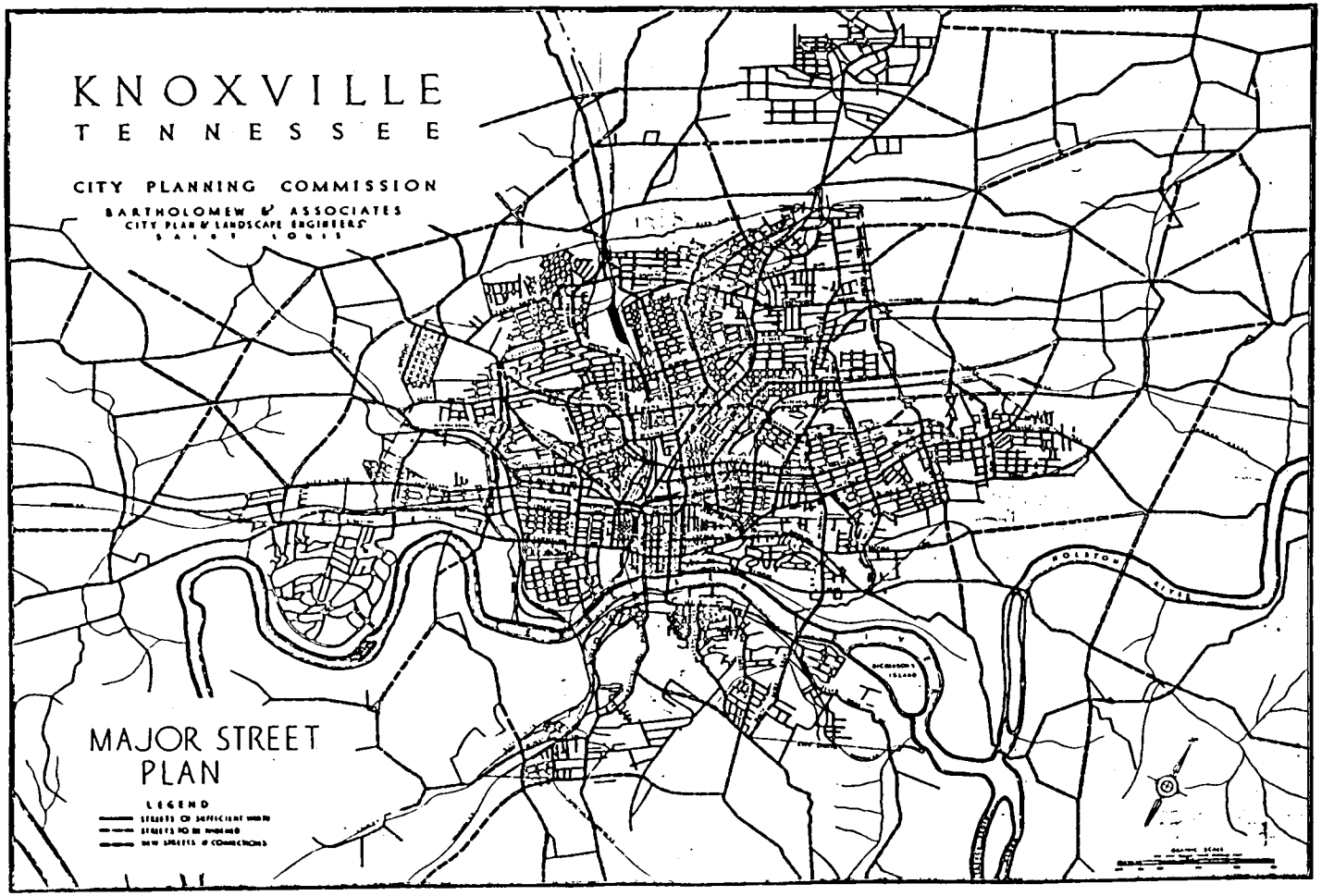


Figure 54. Major Street Plan.

Source: Harland Bartholomew and Associates, A Report on A System of Major Streets for Knoxville, Tennessee (Knoxville, Tennessee: City Planning Commission), p. 40.

Figure 55. Major Street System Diagram.

Source: Harland Bartholomew and Associates, A Report on A System of Major Streets for Knoxville, Tennessee (Knoxville, Tennessee: City Planning Commission, 1927), p. 36.

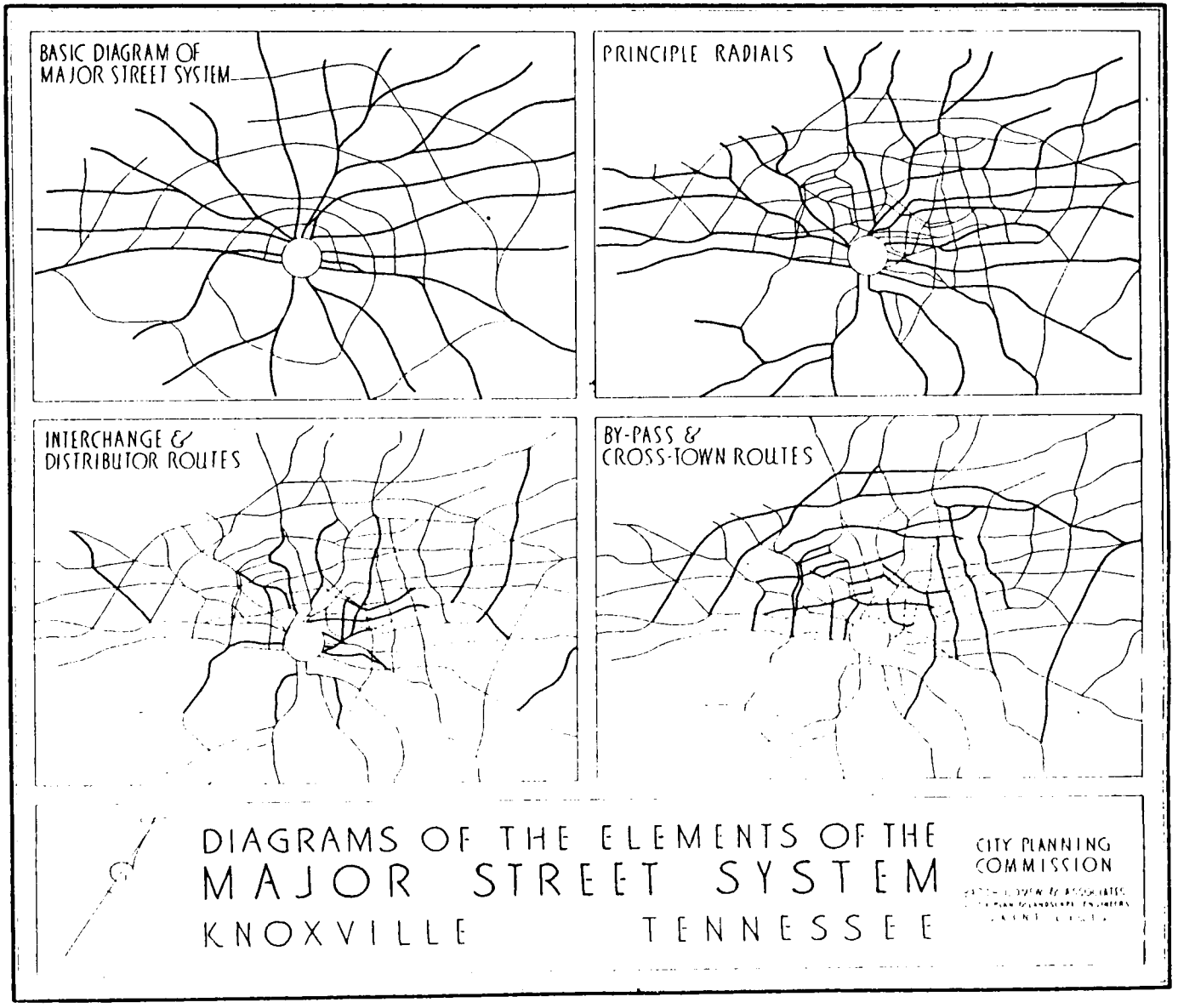

BASIC DIAGRAM OF
MAJOR STREET SYSTEM
PRINCIPLE RADIALS
INTERCHANGE &
DISTRIBUTOR ROUTES
BY-PASS &
CROSS-TOWN ROUTES
DIAGRAMS OF THE ELEMENTS OF THE
MAJOR STREET SYSTEM
KNOXVILLE TENNESSEE
CITY PLANNING
COMMISSION

Figure 55

service to those who live upon it. Knoxville has never made an official classification of its streets to determine which have local and which have city-wide importance. This is done for the first time in the major street plan.

Knoxville has heretofore missed the advantages which come from possession of a major street plan. . . . A city built among hills cannot have a circulation system in which all streets have equal importance. Favored and popular routes are certain to appear. But if no effort is made to co-ordinate these streets in a well-arranged system, their usefulness is frequently lowered far below what it should be. This is what has happened in Knoxville. Attention is directed again to the jogs and dead ends and narrow widths on important highways. . . .

The major street plan has four phases that deserve note. They are:

1. Streets accepted as they stand.
2. Streets too narrow, needing widening.
3. Short extensions or connections to make existing streets more usable.
4. New streets to be laid out as land is platted. . . .

. . . . . .

Streets shown as needing widening are numerous. In this preliminary major street plan no effort has been made to sift the street widening recommendations down to only those which are urgent and can be supported in a definite program of improvements. Some streets need increased width now, such as Henley Street, Wall Avenue and East Vine Avenue. Others will need widening in ten or twenty years, and this future need should be anticipated by establishment of building lines now. The major street plan is an organic composition expressing the eventual requirements of traffic flow.

Short extensions and connections are exceedingly important in the early stages of major street development. . . . Connections are needed to enable the designated major streets to function as a system. Sutherland Avenue and Euclid Avenue should be one continuous street by a connection at Twenty-Fourth Street. Magnolia Avenue is in position and has the width to be one of the most important streets in the major street system, but it dead ends at Sterchi Park. The difficulty of getting into Magnolia from McCalla can be removed by opening a connection through the amusement park as shown in the major street plan [see Figure 54].

The new streets recommended are not for immediate opening, but are shown on the plan merely to guide land owners when the time comes for platting.[257]

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[257] Ibid., p. 40.

Harland Bartholomew and Associates provided a comprehensive list of major improvements to Knoxville's overall street system. The most important improvements included (see Figure 56):

1. The widening and realignment of Henley Street from Hill Avenue to Broadway/Western Avenue.[258]

2. The widening and extension of Wall Avenue.[259]

3. The construction of the Henley Street bridge across the Tennessee River from Hill Street to Blount Avenue.[260]

4. The widening of West Fifth Avenue between Williams Street and Broadway.[261]

5. The widening of McConnell and Olive Streets and extending McConnell Street to Olive Street.[262]

6. The elimination of the jog and bad turn at the intersection of Central Street and Atlantic Avenue.[263]

7. The extension of Fort Sanders Street to University Avenue.[264]

8. The extension of Mitchell Street and Avenue "B" eastward parallel to the Southern Railroad.[265]

9. The extension of Coker Avenue to the east.[266]

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[258] Ibid., p. 5.

[259] Ibid.

[260] Ibid., p. 52.

[261] Ibid., p. 5.

[262] Ibid.

[263] Ibid.

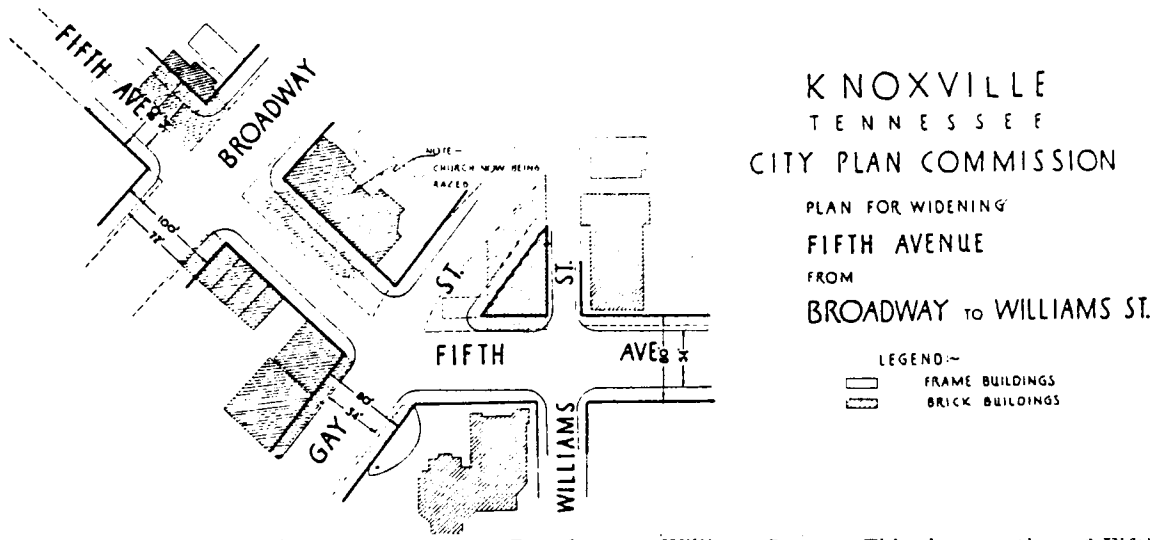
[264] Ibid., p. 52.

[265] Ibid., p. 51.

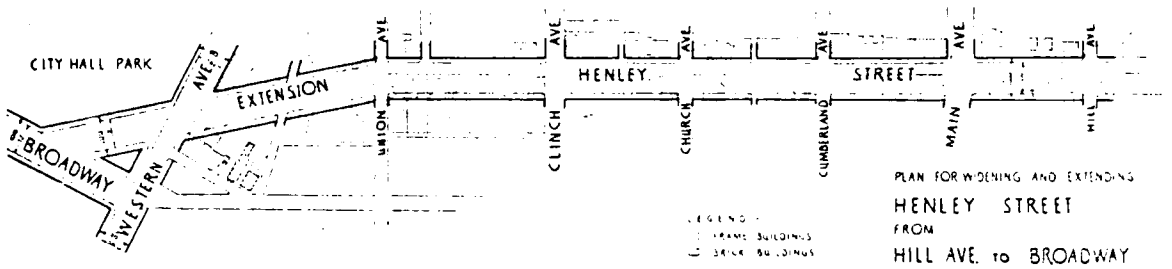
[266] Ibid.

Details of Street Improvements

The short connections and extensions shown on the major street plan are not all of equal importance. Some should be considered immediately, while others may await more favorable conditions. It is recommended that steps be taken as soon as possible to carry out the following projects:



(a) Widening of Fifth Avenue from Broadway to Williams Street. This short section of Fifth Avenue is an extremely important link in the Fifth Avenue route and its present narrow width constitutes a serious obstruction to the interchange of traffic between Broadway and Fifth Avenue east. Upon completion of the Broadway viaduct, present traffic conditions will be materially aggravated due to the largely increased volume of traffic which will turn east of Fifth Avenue from Broadway. The present time is a propitious one for carrying out this project. The property formerly occupied by the Broad Street Methodist church is now free from improvements and should be acquired while in this state. Steps have been taken by the Planning Commission to carry out this project and the matter now is in the hands of the Council.

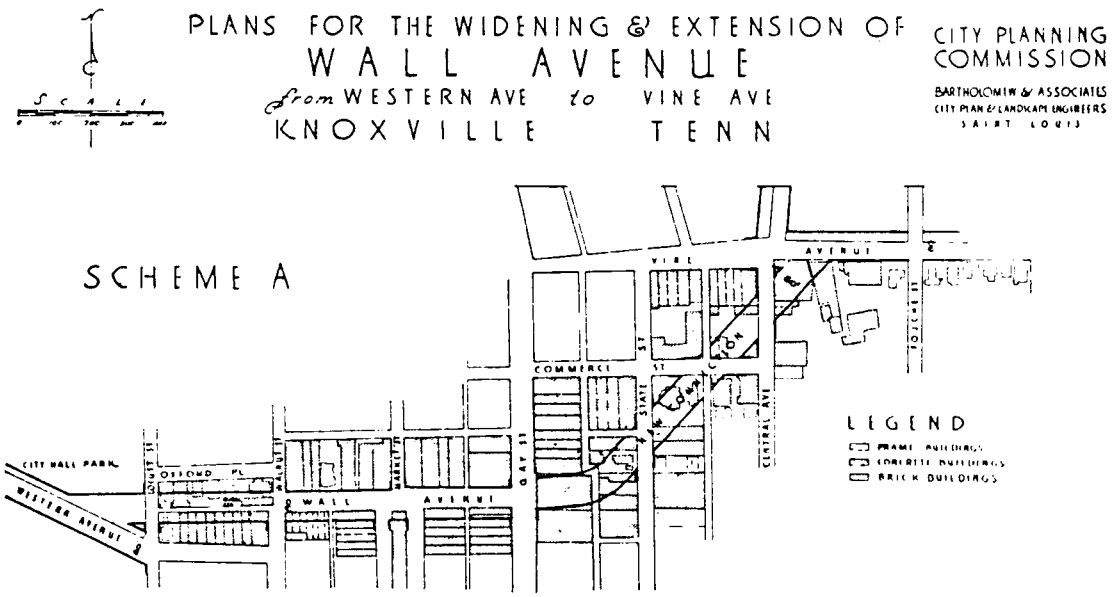


(b) Widening of Henley Street from Union Avenue to Hill Avenue, connecting Henley Street to Broadway at Western Avenue. Broadway, upon the completion of the viaduct is certain to carry a large volume of vehicular traffic. In order to transport this traffic to the business district over a direct route, the plan as shown here is recommended. The property involved in this improvement is all low value and its acquisition should not be unduly expensive. In discussing the need for a wide commodious thoroughfare along the west borner of the congested district three streets have been considered in the analysis of the problem, namely, Broadway, Henley and Locust. In studying the relative merits of these streets, Henley Street was decided upon as being the best suited by reasons of most favorable grades, low value of property affected, desirability as business street and located at a proper distance from Gay Street to allow commercial expansion. Locust Street affords no connection with Broadway, has a number of expensive improvements and is too close to Gay Street. Broadway, south of Western Avenue, is bordered for two blocks by the Louisville and Nashville Railroad, thus lessening its desirability as a business street, is not connected with Clinch Avenue and has steep grades ascending to the business district.

Figure 56. Details of Street Improvements.

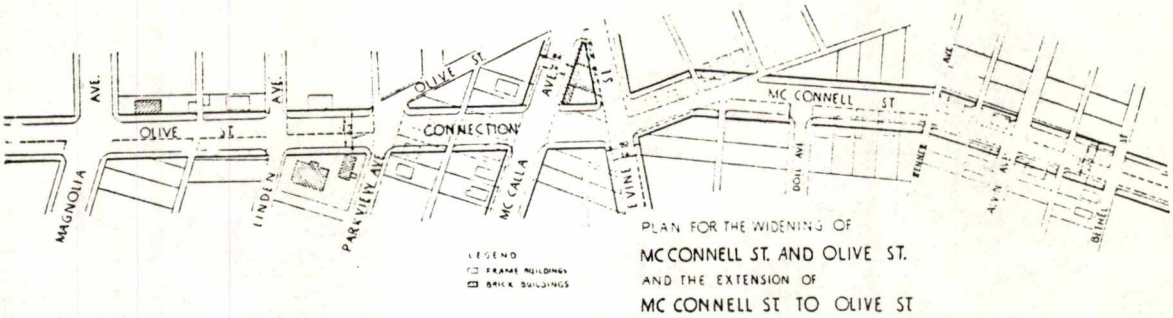
Source: Harland Bartholomew and Associates, A Report on A System of Major Streets for Knoxville, Tennessee (Knoxville, Tennessee: City Planning Commission), pp. 53-55.

(c) Widening and extension of Wall Avenue. The largest single project contemplated in the major street plan is that of providing means for traffic to move east and west along the north border of the business district. Much of the present congestion is due to east and west traffic of necessity using north and south streets. Theoretically, Vine Avenue would be the logical street for this traffic flow, but because of the extreme grades the street is useless. Vine Avenue is so situated as to be the logical northern edge of the business district. Between Wall and Vine, however, is a hill that prohibits extensive commercial developments. Property values are low and streets are ill-adapted to logical business use. The entire hill should be reduced with new streets of adequate widths, logically arranged and of grades approximating three per cent. The cost would undoubtedly be recovered in

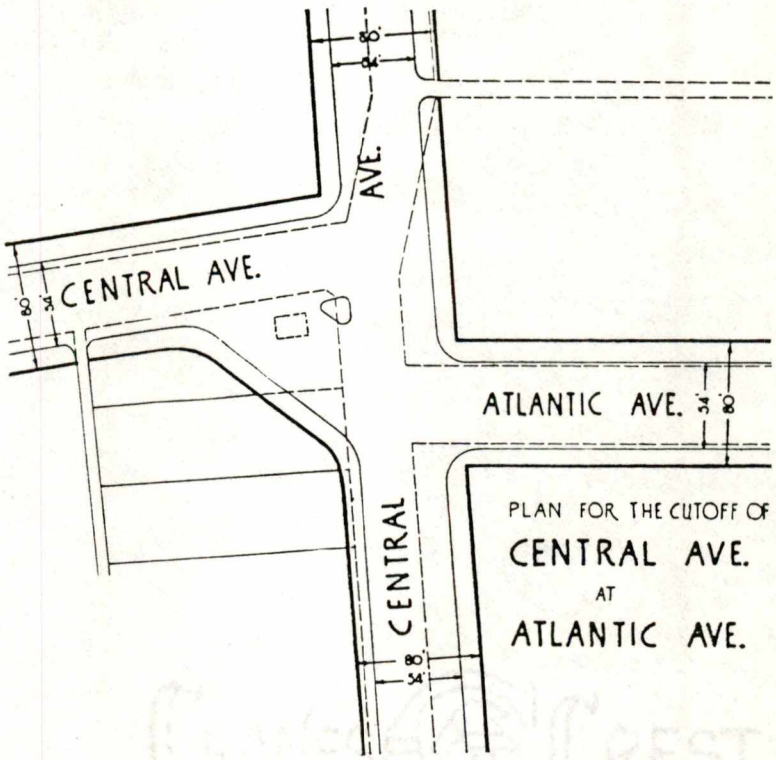


increased value of the property. This is an undertaking of great magnitude and should be the subject of a special study. There is no immediate need for the expansion of the business district here. Wall Avenue can now be improved to serve as a distributor street for Western Avenue, Broadway, Central Street, Gay Street and Vine Avenue. It is so situated as to admirably serve this purpose, even though at some later date the hill to the north is removed and Vine Avenue is widened to serve also as a distributor street. The extension of Wall Avenue to Central Street is especially important, particularly in connection with a further grade separation of Central Street at the Southern Railway. Wall Avenue should then be converted into a double-decked street east of Gay, the upper level connecting directly from Gay Street to the viaduct level of Central Street over the tracks and to Vine Avenue to the east. If this improvement were completed, together with the opening and widening of Henley Street, the widening of Central Street and the widening of Main Avenue ,the business section would then be surrounded by wide thoroughfares acting as distributors for traffic bound for the heart of the business district.

Figure 56 (continued)



(d) Widening of McConnell Street and Olive Street and extending McConnell Street to Olive Street. These two streets are links in a very important route extending from Riverside Drive and Dandridge Avenue to the Park City section. Its present condition is such as to discourage traffic use and because of the inadequate widths and turns on McConnell Street permanent improvements are impossible to make. The street should be straightened, the extremely bad turn at Vine Avenue and at Linden Avenue eliminated and an adequate width secured.



(e) Elimination of jog and bad turn at Central Street and at Atlantic Avenue. This improvement could be carried out by the city at little cost at the present time due to the unimproved property affected and the willingness of the owners to co-operate. The Central Street turn is dangerous and its correction would also eliminate the jog now existing at that point.

Figure 56 (continued)

10. The connection of Fairmont Boulevard to Aviation Road with the view of the future eastward extension of Aviation Road.[267]

11. The re-location of Broadway at the north city limits to provide better connection with Whittle Springs Road and to eliminate the dangerous grade crossing now existing near that point.[268]

12. The extension of Central Street near its intersection with Heiskell Street across undeveloped property to intersect with Johnson Street.[269]

13. The laying out of a new connection from Central Street at the north city limits, crossing the Southern Railroad by means of a subway, and joining Central Street at the intersection of Atlantic Avenue.[270]

14. The re-location of the Cherokee bridge and the development of a wide continuation of Concord Street north of Sutherland Avenue extending to Western Avenue.[271]

15. The two jogs on Atlantic Avenue, at Felts Street and Pershing Street, should be straightened.[272]

All of the above named recommendations were carried out by the City of Knoxville except for number 6. The most significant street design improvement was the construction of the Henley Street bridge and later Chapman Highway. These improvements provided travelers direct north-south movement to South Knoxville and the Great Smoky Mountains National Park. These improvements also influenced the

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[267] Ibid.

[268] Ibid.

[269] Ibid.

[270] Ibid.

[271] Ibid.

[272] Ibid., p. 52.

design and layout of many subdivisions and streets south of Knoxville.

Recommendation number 2, the widening and extension of Wall Avenue, was completed some forty years later when the City of Knoxville constructed Summit Hill Drive in 1976 in conjunction with the Summit Hill redevelopment project. This link today provides an important east-west connection across the north end of the CBD.

Supplementing their list of proposed improvements to Knoxville's overall street system, Harland Bartholomew and Associates provided a comprehensive set of guidelines and principles for the subdivision and platting of new land. These guidelines and principles were primarily directed toward the design of subdivision streets and thoroughfares in Knoxville. Figures 57 and 58 provide graphic representation of the proposed guidelines and principles described below.

1. Conformity to the major street plan in the matter of width and alignment. These particular streets should be contiguous, as direct as possible, of adequate width and easy gradient.[273]

2. Proper adjustment of streets to the contour of the ground. In general streets of all types should run parallel to contours. The lots on the upper side of the street will rise to the rear; those on the lower side of the street wil drop to the rear. It is found that lots sloping thus are much more easily sold and used for residential purposes than those along a street which runs straight up a hill.[274]

3. The platting of streets and lots along diagonal thoroughfares deserves special attention. Pleasure drives, moreover, should be laid out so that full depth, desirable lots may be laid out on them.[275]

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[273] Ibid., p. 61.

[274] Ibid.

[275] Ibid.

Figure 57. Principles of Land Subdivision.

Source: Harland Bartholomew and Associates, A Report on A System of Major Streets for Knoxville, Tennessee (Knoxville, Tennessee: City Planning Commission, 1927), p. 60.

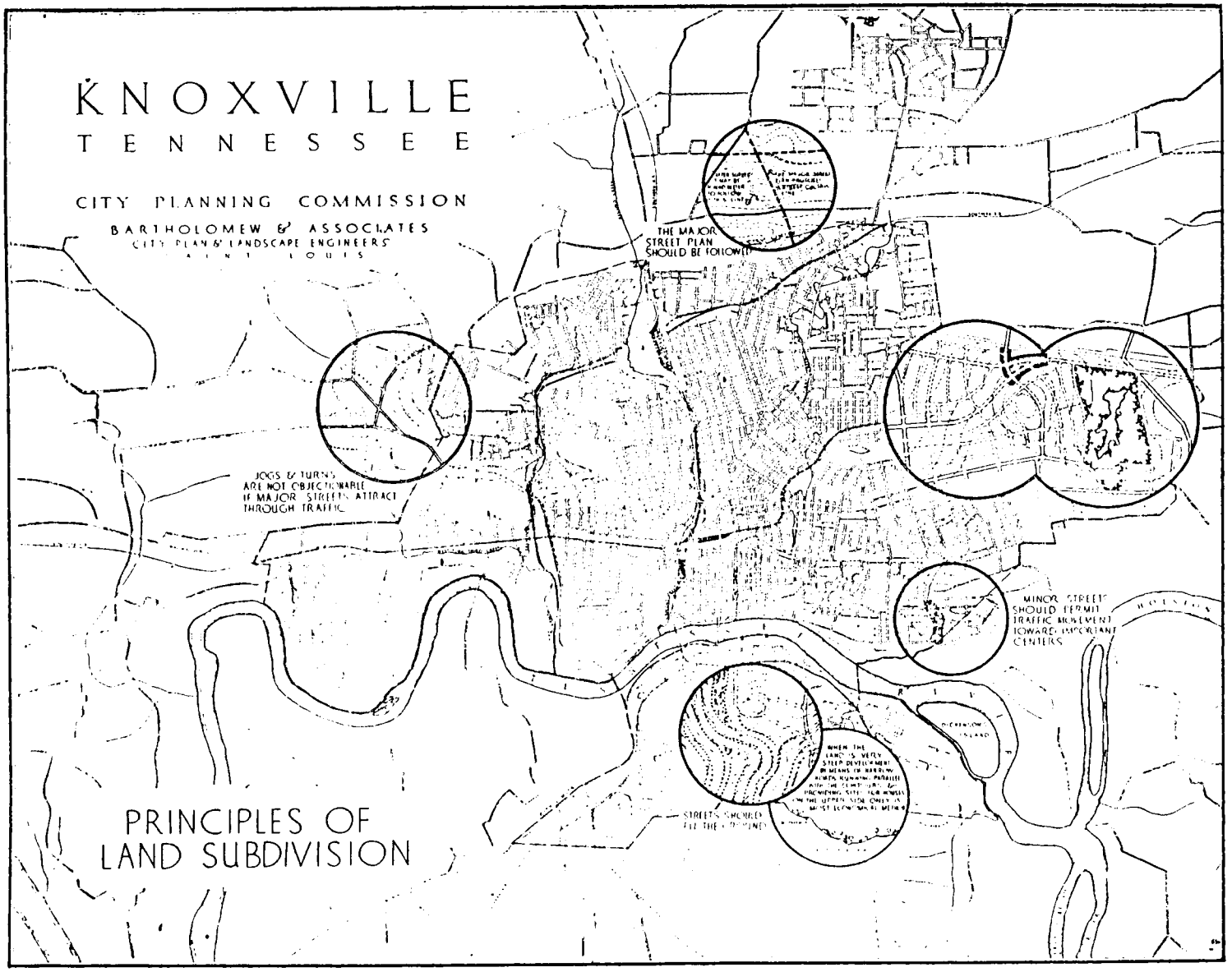

KNOXVILLE
TENNESSEE
CITY PLANNING COMMISSION
BARTHOLOMEW & ASSOCIATES
CITY PLAN & LANDSCAPE ENGINEERS
THE MAJOR STREET PLAN SHOULD BE FOLLOWED
JOGS & TURNS ARE NOT OBJECTIONABLE IF MAJOR STREETS ATTRACT THROUGH TRAFFIC
MINOR STREETS SHOULD PERMIT TRAFFIC MOVEMENT TOWARD IMPORTANT CENTERS
PRINCIPLES OF LAND SUBDIVISION

Figure 57

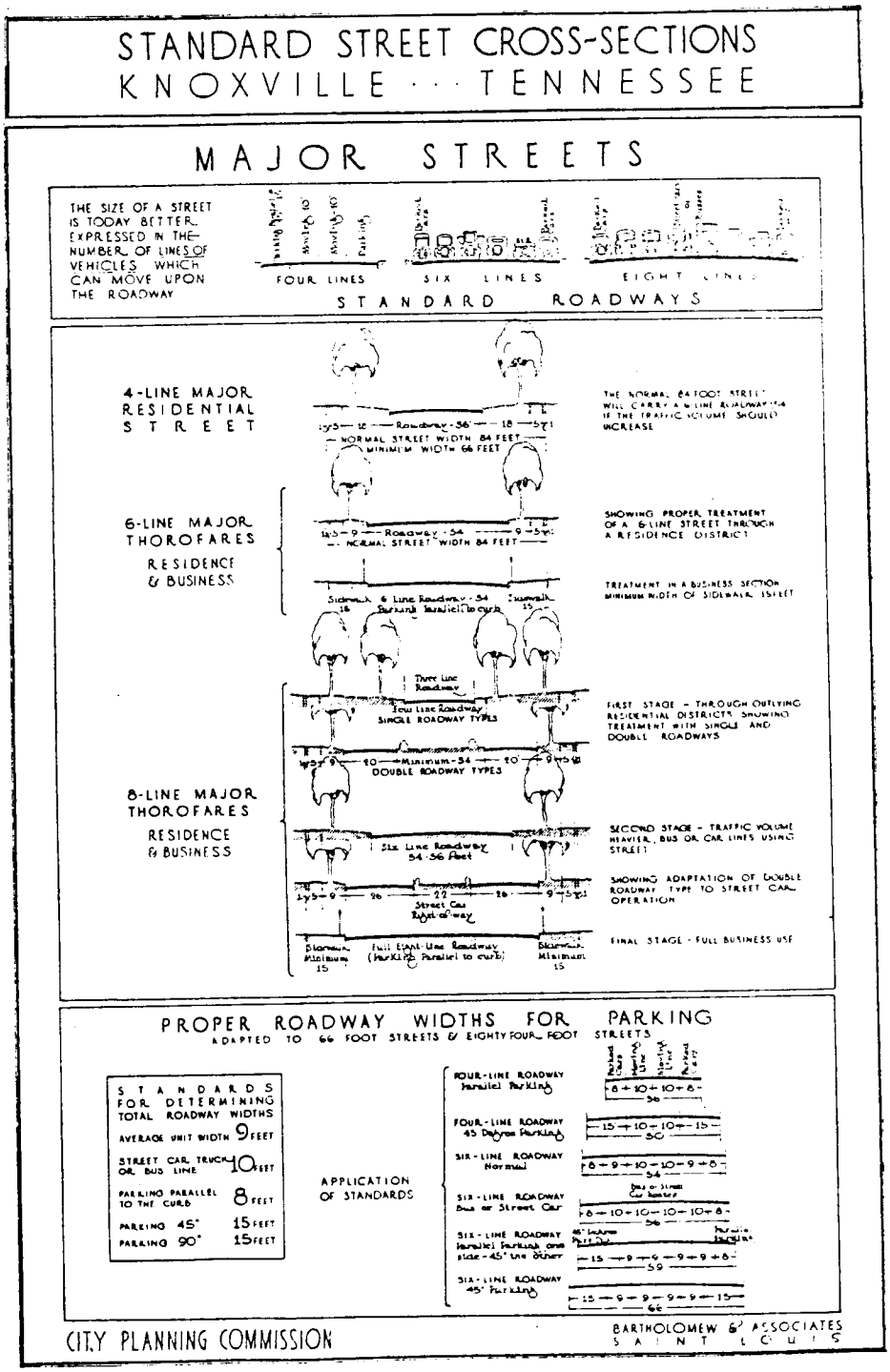


Figure 58. Cross-Sections of Streets.

Source: Harland Bartholomew and Associates, A Report on A System of Major Streets for Knoxville, Tennessee (Knoxville, Tennessee: City Planning Commission, 1927), p. 58.

4. The arrangement of minor streets should be such as to favor the general flow of traffic to the principal arteries.[276]

5. Jogs and abrupt turns are especially to be avoided on major streets. On minor residential streets, however, such impediments to traffic tend to protect them from any undesirable circulation of heavy, through traffic.[277]

6. Intersections on major streets deserve special study. . . . The traffic problem where several important arteries intersect should also be anticipated and the intersection designed to reduce congestion and confusion to a minimum.[278]

Three years later, in 1930, Harland Bartholomew and Associates completed "A Comprehensive City Plan," in which streets were but one element of the plan. However, from the firm's description the street system element was considered the most important.

The street system is the fundamental element of the city plan. It is the skeleton or framework of the city structure. There are three types of streets that every well-planned city should have:

1. Main arterial thoroughfares.
2. Secondary (crosstown) thoroughfares.
3. Minor streets.

The main arterial thoroughfares should . . . provide continuous and direct communication between the central business district and all parts of the city. They may be compared to the spokes of a wheel, radiating in all directions from the hub. . . .

. . . . . .

Where the rectangular form of street platting has been followed, as is the case in most cities, these secondary crosstown thoroughfares should be placed approximately one-half mile apart. . . .

. . . . . .

Minor streets are those which chiefly serve residential districts. Their design and arrangement should facilitate access to such districts, but should not provide for or encourage anything but "local" traffic. . . . The platting of minor residential

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[276] Ibid.

[277] Ibid.

[278] Ibid.

> streets should not be of the rectangular type alone. Variation in topography often justifies departure from this method, and where there is no variation in topography, a modification of the rectangular street pattern often introduces a greater degree of interest and charm into the district.[279]

In the comprehensive plan for Knoxville, Harland Bartholomew and Associates discussed the need for a variety of "major streets" to carry most of the every-growing traffic loads. From a functional standpoint, the classification included: 1) Principal Radial Arteries, 2) Distributor and By-pass Streets, and 3) Cross-town and Interchange Routes. Each of these street classifications were proposed in order to relieve the heavy traffic congestion in the CBD. The Principal Radial Arteries were to be facilities similar to Kingston Pike and Broadway, radiating out like spokes on a wheel. Distributor and By-pass streets were propsed to be facilities to relieve or distribute traffic pressure off of the Principal Radial Arteries. "Knoxville, because of the limited traffic capacity of streets in the business center and topographic conditions therein, needs several well-developed by-pass routes."[280] Cross-town and Interchange Routes were the forefathers of the modern freeway and expressway system. It called for their placement "at approximately every half mile, although in rough country the standard spacing and regular arrangement are not

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[279]Harland Bartholomew and Associates, A Comprehensive City Plan, Knoxville, Tennessee (St. Louis, Missouri: Harland Bartholomew and Associates, August 1, 1929), p. 29.

[280]Ibid., p. 40.

easily maintained."[281] Major streets were also to be designed with the following principles in mind: 1) directness, 2) continuity--no jogs or dead-ends, and 3) adequate width, based upon a computation of traffic loads and a predetermined scheme of thoroughfares.[282] However, they added an important qualifier to these principles by stating that:

> . . . obviously, in reconditioning old streets in the interior of the city, it will not always be possible to apply all of the above standards. Outside the city, however, the major street plan may be executed with full effectiveness. Land subdivision practice, the primary source of past mistakes in street planning, should be modified immediately to meet the requirements of the city's new street development policy.[283]

Harland Bartholomew and Associates also examined the effects of the existing railroad lines on the overall street pattern and traffic flow in Knoxville. Because of the significant amount of accidents and wasted time at railroad crossings, a series of viaducts were proposed to be built over these dangerous intersections.

> The original railroad structure within a city usually has acquired its form as a result of topographical limitations. Necessary, it has followed the path of least resistance, which is that of easy grades and low property values. . . .
> . . . . . .
> The major street plan has designated certain thoroughfares as major streets. Several of these now cross railroad tracks at

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[281] Ibid.

[282] Ibid., p. 62.

[283] Ibid., pp. 63, 65.

grade, as Broadway once did. In many instances, the necessity for a separation is now urgent.[284]

Concluding their discussion:

> The grade crossing situation in Knoxville shows indications of becoming acute within the next few years. The many viaducts and subways already constructed by the railroads and the city, have in practically every instance demonstrated their beneficial effect in accelerating traffic and contributing toward the development of both industrial and residential areas.[285]

In examining the list of thirty-seven proposed viaducts and/or subways, only two of these projects were ever implemented. These are the Western Avenue viaduct and the Seventeenth Street viaduct reconstruction. All of the remaining thirty-five streets have at-grade crossings with either Southern Railway or the Louisville and Nashville Railroad, and continue to plague traffic movements within the city. Although many of these grade crossings include minor or low-traffic volume streets, their effect, in aggregate, has been detrimental to motorists in Knoxville. Many of these conflicts could have been avoided with a properly designed street system.

Knoxville's first real taste of modern traffic engineering was initiated by the comprehensive city plan of 1930. This was due, in part, to two major factors: the tremendous increase in the number of vehicles on the city's streets, particularly in the CBD, and the overall poor design of the city's streets. Traffic congestion became

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[284] Ibid., p. 86.

[285] Ibid., pp. 96-97.

a problem for the residents of Knoxville in 1930. Solutions to these problems were needed and were provided by the plan. In examining the city's CBD, Harland Bartholomew and Associates concluded that:

> The area studied in this survey is destined to serve for a great many years as the principal business section. As the street space is already inadequate to meet the demands for parking, it is apparent that conditions in the future will be much more aggravated. The only solution to the problem is to provide space from the city's streets for the storage of vehicles. The time is rapidly approaching when all important traffic-carrying streets in the congested sections will be cleared of parked vehicles to allow the greatest possible freedom of moving traffic.[286]

The last important section of Harland Bartholomew and Associates' comprehensive plan was the establishment of the "City Planning Enabling Act." This Act provided a legal basis for the adoption of an "Official Map" for the city of Knoxville. Sections 18 and 20 of the Act called for the establishment of specific procedures for laying out and planning/dedicating land for city streets. The Appendix contains the text of these sections. The importance of this legislation in the proper planning and design of Knoxville's street system has remained constant for the last fifty-three years. Because of this Act, all streets planned for the city of Knoxville were required to be reviewed publicly. At least, the City of Knoxville had the tools to properly plan for, and improve the city's street system. It now became the responsibility of the city's planning commissioners and elected officials to carry out the specifics of the comprehensive plan.

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[286] Ibid., p. 183.

> Official mapping provisions are another kind of land use control that implements planning. An official map gives precise locations of future streets within and sometimes without a municipality and sometimes also includes park sites and sites for other public improvements. The basis for the regulation is that there is hardly any determinant of future land development as important as the location of future streets. If buildings are placed that interfere with the logical extension of streets, the public authorities are put in the unenviable position of placing major streets around scattered existing development or acquiring improvements at great cost.
>
> The Standard City Planning Enabling Act provided that a plat of an area could be adopted showing streets for future acquisition. Adoption of the plat was a reservation of the indicated streets but was neither the opening of a street nor the taking of land. The Standard Act provision was not widely adopted. The means were too expensive, since compensation was paid for the reservation for whatever period of time land was reserved. When the street itself was opened, the Act provided that additional compensation would be paid, except for buildings erected in contravention of the easement.
>
> In addition to adoption of a major street plat, streets could also be approved under the Standard Act if shown on the master plan, if on an approved subdivision plat or if specially approved. Unless approved in one of these ways, Section 18 of the Act provided the municipality could not accept, lay out, open, improve, grade, pave, curb or light any street, or lay or authorize water mains or sewers. In addition, buildings could not be erected nor building permits issued unless the street giving access to the building had been approved in one of the four ways.[287]

During the 1930's, life for Knoxvillians was influenced by the Great Depression. Many of the aforementioned street improvement projects were carried out by cheap labor during this period. The creation of the Tennessee Valley Authority (TVA), and the Works Progress Administration (WPA) assisted the City of Knoxville in completing these projects with federal aid. One interesting project completed by TVA during the Depression was the planning and

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[287] Donald G. Hagman, Urban Planning and Land Development Control Law (St. Paul, Minnesota: West Publishing Company, 1975), pp. 270-271.

construction of Norris Freeway. This limited-access road was built to provide direct access from the city of Knoxville (the headquarters of TVA) to TVA's first project, Norris Dam. WPA's effort in Knoxville included the construction of the Church Avenue viaduct and several area "farm-to-market" roads.

Knoxville's first traffic safety survey was conducted by the Tennessee Emergency Relief Foundation in 1934. This interesting study was the city's first comprehensive look at the causes and conditions of traffic accidents in Knoxville. The study's Introduction provides a clue as to some of the causes of traffic accidents in the city:

> When it is considered that the physical layout of Knoxville has undergone but little improvement . . ., and that this layout is peculiar by reason of the steep grades, the many jogs and dead ends and the unusually narrow streets, it is easy to understand the increasing number of accidents and delays in movement. A conservative estimate of the economic loss due to these accidents and delays in Knoxville is in excess of two million dollars per year.[288]

The basic recommendation of this extensive study called for the construction of a series of viaducts over all railroad facilities adjacent to Knoxville's CBD, the widening and realignment of many streets, the placement of modern traffic control devices and signage at all intersections, and the education and the enforcement of traffic regulations. The information and findings presented in this study provided additional evidence to local officials that the city's antiquated street system had some serious deficiencies.

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[288]Thomas D. Lebby, A Traffic Safety Survey of Knoxville, Tennessee (Knoxville, Tennessee: Tennessee Emergency Relief Foundation, 1934), p. 4.

In continuing his analysis of Knoxville's street patterns, Victor Albert Hyde described the existing street layout in 1939:

> The area from Twenty-third Street to the intersection of Main and Vine Avenues, and from the Tennessee River northward to Vine Avenue and Grand Avenue further west, constitutes the core about which all the street patterns in general tie up. In this area, the streets are so constructed that practically all of them intersect at right angles. This section carries the greatest amount of traffic in the city, and although streets are so arranged that traffic flow should be easy, congestion is a common occurrence due to the street's extreme narrowness. . . .
>
> . . . . . .
>
> Vine Avenue northward to Bluff Street, between Broadway and First Creek, represents a second definite street system. The streets in the southern portion of this area are correlated with the major streets of the central region, but from Lovenia Avenue northward, the major streets come in at oblique angles.
>
> East of this pattern, lying between the main line of the Southern Railway on the north, and Brooks Avenue on the south, is one of the best planned street systems in the city. The streets are fairly wide, and what discrepancies there are in regard to regularity can be attributed to relief.
>
> North of the region described, and east of Central Avenue Pike are three areas in which pattern varies considerably. From the old Gray Cemetery following Broadway to Ledgerwood Avenue, and thence westwardly to the Southern Railway line, and following the railway line to the starting point is another well-planned section of the city. Here the streets intersect at right angles, and the greatest difficulty encountered is the fact that the blocks are of unequal lengths, thus causing a considerable number of streets to terminate in dead ends.
>
> West of Broadway and north of Ledgerwood Avenue to the city limits is an area in which street pattern is largely determined by the pre-existing railway line. Some of the streets intersect at right angles, some at oblique angles, and others at points that seem convenient. Most of the streets in this general area connect with the north end of Broadway, thus giving rise to a commercial district, as the trend of the streets is away from the older sections of the city.
>
> The region lying north of the Southern Railway line to Bristol and east of Broadway represents an area in which the street pattern is the result of attempts to match the streets of the neighboring areas that were developed at an earlier date. In the southern portion regularity is noticeable, while in the other parts streets exist wherever conditions can be made with Broadway.
>
> West of Second Creek and north of New York Avenue is an area in which three sets of parallel blocks meet obliquely to each other. As a result, dead-end streets, irregular length of blocks,

and crooked streets are in evidence. The streets in general are poorly taken care of, as the region is in close proximity to the Coster Railway Shops, which represents an industrial area.

Directly south of this section, between the Louisville and Nashville Railway line on the west, and the Southern on the east, to Dale Avenue on the south, is the most poorly planned section in the city. Streets intersect at all angles, and connections with streets in other areas are obstructed in all directions by railway lines. The surface features do not readily lend themselves to the building of roads, and as the region is occupied principally by negroes, public interest in planning has been very slight.

In the extreme western portion of the city west of the New Gray Cemetery between Western and Keith Avenues, is a new development in which regularity is prevalent. Such a planned section, in an area which is so badly cut up, has little real value as it does not fit in with the existing pattern, and does not connect with other conformable districts.

South of Kingston Pike, between Third Creek and the city limits on the west, is a street system which is not in any sense connected with the heretofore mentioned systems. The main roads within the area connect with the Kingston Pike, and the roads curve frequently following the bend of the Tennessee River. This area represents the highest type of residential section within Knoxville, and winding boulevards predominate.

In that portion of the city south of the Tennessee River, the streets are badly broken up, and in only a few cases are sections fairly regular. However, such planning can be understood when the rough topography is observed, and the fact that a definite attempt has been made to develop a residential section distant from the river similar in plan to that employed in Sequoyia Hills.

Surrounding the areas mentioned, are numerous other streets that can hardly be considered systems or patterns. Those regions are undeveloped, and where streets do exist they are mainly connecting links between the more highly developed sections of the city.[289]

E. AFTER WORLD WAR II, 1940-1960

Knoxville during the 1940's and 1950's was characterized by a tremendous slowdown in the city's economic and population growth. This decline led to a stagnation in the city's physical growth, and as a result became the only period of time when annexation did not occur.

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[289] Victor Albert Hyde, op. cit., pp. 47-51.

Instead, the city focused its attention on improving the existing conditions of its housing stock, school system, parks and recreation facilities, and overall street and highway network. City planning of this era was aimed at improving the physical components of Knoxville. Many planning studies were developed during this period to assist in the improvement of the city's physical woes.

> In 1941, Harland Bartholomew and Associates was again employed by the city planning commission, this time to review a plan for the Knoxville waterfront. The plan was prepared by the planning engineer, Frank Jones, with assistance from the planning staff of Tennessee Valley Authority, to provide a basis for adjustments in streets and land use which might be required by the construction of the TVA Fort Loudoun Dam. The plan, adopted by city council October 7, 1941, recommended waterfront parks and a riverfront highway from Concord Street to Riverside Drive. The latter proposal was eventualy to materialize as Neyland Drive and the Downtown Loop.[290]

The primary objectives of the riverfront plan was to:

1. Provide an east-west by-pass around the business district [see Figure 59],
2. Reduce congestion at the University of Tennessee stadium,
3. Provide accessibility to new downtown parking areas,
3. Serve the terminal,
4. Open up the central waterfront for recreation, and
5. Provide opportunities for enjoying views along the river.[291]

A few years later, in 1945, the City Planning Commission, led by Chief Planning Engineer Walter S. Smith, provided the city of Knoxville with the first major update of the original major street

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[290] Lucile Deadrick, op. cit., p. 118.

[291] City Planning Commission, Knoxville, Tennessee, Plan for Riverfront Development (Knoxville, Tennessee: City Planning Commission, 1941), no page given.

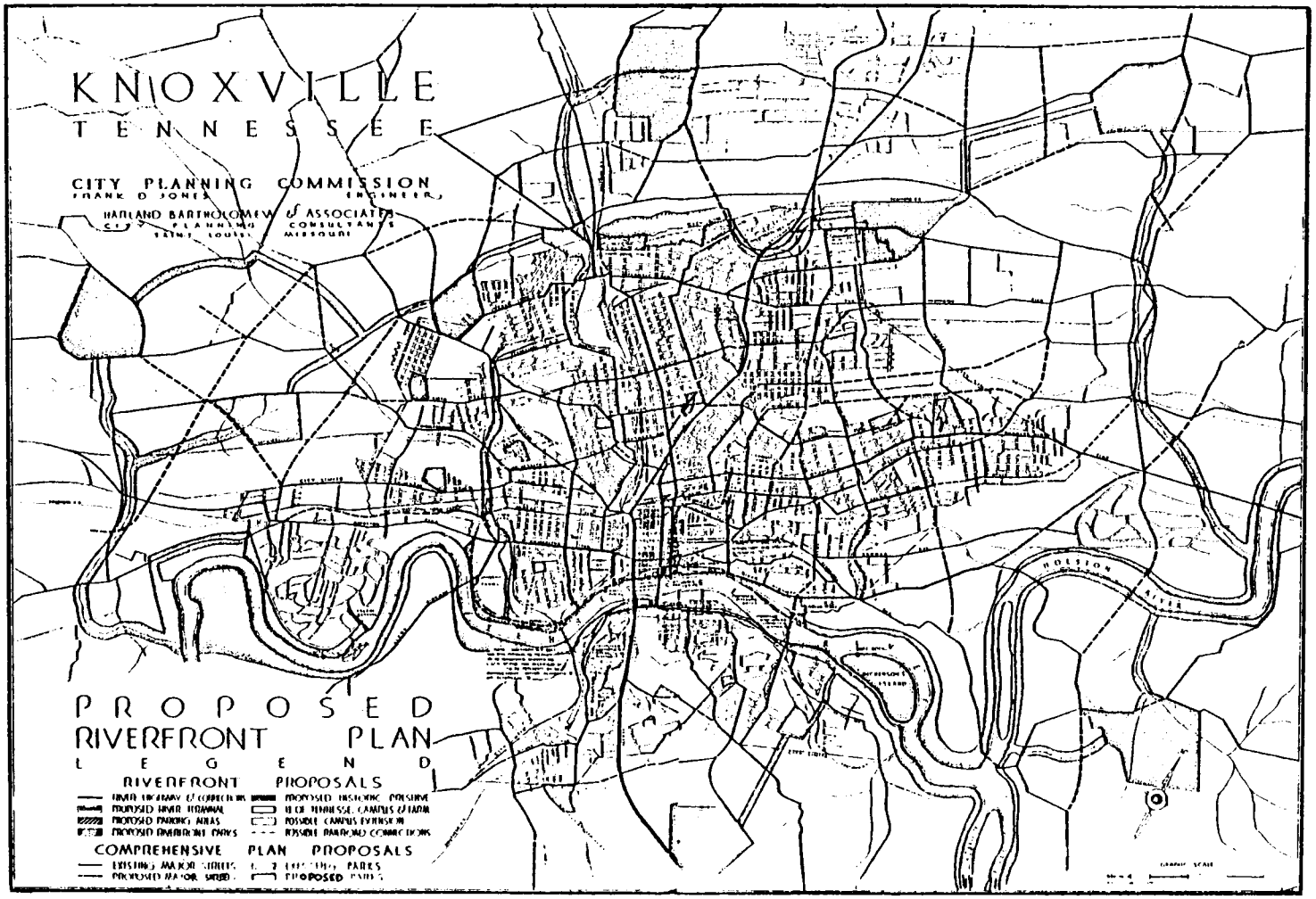


Figure 59. Riverfront Plan.

Source: City Planning Commission, Knoxville, Tennessee, Plan for Riverfront Development (Knoxville, Tennessee: City Planning Commission, 1941), no page given.

plan submitted in 1927. Of particular interest, the street plan was coordinated with the plans of Knox County and the Knox County Planning Commission for the first time ever. The content of the study included a tremendous series of street-by-street design recommendations for the entire city of Knoxville and portions of Knox County. Some of the most important street design recommendations which were eventually implemented included:

> The Clinton Pike beyond the city limits has been widened as a boulevard by construction of an additional concrete pavement of equal width, each pavement to carry one-way traffic in opposite directions. The present connection to Central Street through an underpass twenty feet wide with two sharp right-angled approaches is considered inadequate and dangerous. Central Street itself is not considered adequate to carry all the traffic thus brought into the city's north central area. Its connections with the area to the west are limited in slope by the railroad and the grades are rather bad.
>
> If a new arterial street were built on the west side of the Southern Railroad it would relieve much of this traffic. If extended all the way to the west end of the Oak Avenue viaduct via Van and Marion Streets as indicated, it would be one of the most important streets in the city, giving access to all the West Knoxville area, and a direct connection between all roads converging at Sharp Gap all the way to Henley Street bridge and Chapman Highway. Later it will doubtless be found necessary to add another parallel viaduct to the Oak Street viaduct. In fact it may be found desirable to protect the route to the intersection of Henley Street and Western Avenue with a new viaduct across the railroad. . . . It will hereinafter be referred to as the Marion Street extension.[292]

Of course, the two paragraphs above are the first descriptions of the new Clinton Highway and the predecessor of Interstate 75 and later 275. The whole facility would be called the North-South Expressway, linking north Knoxville with downtown. Figure 60 shows

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[292]City Planning Commission, Knoxville, Tennessee, Major Street Plan (Knoxville, Tennessee: City Planning Commission, 1945), p. 7.



Figure 60. Knoxville in 1945.

Source: City Planning Commission, Knoxville, Tennessee, Major Street Plan (Knoxville, Tennessee: City Planning Commission, 1945), fold out map.

the proposed alignment virtually the same as the existing freeway configuration. However, it would be still a number of years before this road was constructed. Regarding the alignment and design of this facility:

> Another important point to consider in connection with this route is that the greater portion lies in relatively unimproved areas. In the southern portion where it is necessary to cut diagonally across a more settled area, the property is of depreciated quality.
>
> Still another primary consideration is that the western ends of the present viaducts across this railroad are relatively difficult to access. The pattern of adjacent streets in the area is crooked and intricate, forming labyrinths not conducive to smooth traffic flow. The proposed Marion Street extension should go far to alleviate this condition. Improvement and widening of Clark Street to the end of the recent built extension of the Western Avenue viaduct would serve as a connection between Fifth Avenue and Euclid Avenue and between Euclid Avenue and the Marion Street extension, and would serve as a by-pass for traffic between these last two streets.[293]

At the same time, interest was being generated for an east-west expressway (see Figure 60). This facility would be the predecessor to Interstate 40.

> The improvement of Magnolia Avenue has long been a principal item in the major street plan. At the present time the State Highway Department is vitally interested in pushing Magnolia Avenue through to Euclid Avenue to Sutherland Avenue and the Lee Highway (now Kingston Pike and U.S. 70). This route would require another viaduct which would connect with the Marion Street extension north of its connection with the Oak Avenue viaduct.[294]

As was described above, the Marion Street extension and the Magnolia Avenue extension would be designed so that they would

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[293] Ibid., p. 8.

[294] Ibid.

intersect one another, to provide direct access in four different directions. This freeway intersection would later become the infamous Malfunction Junction. Other important projects that affected the overall street pattern of Knoxville included:

> Another road to the Clinton project is the Oak Ridge Road now being built, which follows the general route of the old Ball Camp Road to Cheneworth Gap in Beaver Ridge, and leads to the Solway Bridge entrance to the project. This is now regarded as an extremely important road and one which would eventually become a link in the main highway to Nashville. But the present situation from the point at which this road crosses the city limits eastward into the city along Western Avenue is deplorable. Western Avenue turns sharply south at the railroad and this curve has poor visibility. Then there is a grade crossing at Keith Avenue; a curve and hilltop at Brandau Street, which also has poor visibility, and the roadway is no wider than necessary for two passing vehicles. Yet cars are often found parked on this curve and the condition is hazardous in the extreme. All of Western Avenue is considered too narrow for the traffic it is now required to carry, but the condition is especially bad in the commercial district just north of University Avenue, where parking is allowed on both sides of the street. This does not allow room for two lanes of passing vehicles and causes great obstruction to traffic.[295]
>
> University Avenue should be extended to Middlebrook Avenue as shown on the original street plan. Its present connection with Euclid Avenue via Twenty-fourth Street is a steep grade.[296]
>
> The 1941 River Front Plan showed a cut-off from Wilder Place at Natchez Avenue to Riverside Drive at Hall Street, thence across the River to South Haven Road. This route would cut through a new housing development and would evidently require a longer bridge across the brick pits than the one across the river, and is not recommended.[297]

The original major street plan proposed to connect Walker Boulevard and Whittle Springs Road with South Haven Road as a major

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[295] Ibid.

[296] Ibid., p. 10.

[297] Ibid., p. 15.

north-south facility. This idea was never carried out as was the proposal described above, however, a new bridge was recently completed across the Tennessee River linking South Knoxville with East Knoxville and the CBD. Although the alignment of the South Knoxville Bridge and Boulevard did not follow the proposed alignments described in the 1927 and 1945 plans, it did follow the idea that an additional bridge would be needed in South Knoxville to relieve traffic congestion on the Gay Street and Henley Street bridges.

Preceding the construction of the John Sevier Highway was a proposal creating a link between Chapman Highway and Alcoa Highway.

> Young Avenue should be extended to Maryville Pike at its intersection with Maloney Road, by way of Angelina Drive and Avenue "D." The present underpass on Maloney Road is hazardous and should be replaced. Most of this route is in the county. It would be an important cross-road connecting the Chapman Highway, Maryville and Martin Mill Pikes, and the Alcoa Highway. The State Highway Department is definitely interested in this route, and it is of course an extension of the Whittle Springs-South Haven Road route.[298]

An interesting final note regarding this study is the fact that all maps and diagrams reflecting the text of the report were not originally included in the body of the report because of defense considerations. Due to World War II, all graphics were not inserted in the plan until clearance had been given by the United States Government. All plans and maps were kept at the City Engineering Department during the war.

> Both these last-named topographic maps are U.S. Coast and Geodetic Survey maps on which the proposed major street system has

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[298] Ibid., p. 17.

> been superimposed. Both are designated "restricted" as containing "information affecting the national defense of the United States within the meaning of the Espionage Act" and at present cannot be attached to this report for use by unauthorized persons. When restrictions are lifted blueprints of the last-named map may be attached to this report.[299]

In 1948, the H.W. Lochner and Company, and the DeLeuw, Cather and Company transportation planning firms were hired to prepare a highway and transportation plan for the city of Knoxville. Their highway and transportation plan was basically a refinement of the proposals made in the 1945 major street plan. Much of this study was directed at the development of a system of high speed arterials and expressways for Knoxville. In the "Letter of Transmittal" this point was emphasized.

> In considering the higher type highway facilities required in Knoxville it was determined that freeway construction could not be economically justified on the basis of anticipated traffic use. Expressways incorporating several freeway features are recommended as being necessary and economically practicable.[300]

Because of the availability of post-war automobiles and gasoline, traffic congestion became acute, particularly in downtown Knoxville. Two basic solutions were offered in the plan: make improvements in the function and design of streets in and leading to downtown Knoxville, and construct a series of freeway-type expressways and arterials radiating from the CBD. The recommendations submitted

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[300] H.W. Lochner and Company, and DeLeuw, Cather and Company, Highway and Transportation Plan, Knoxville, Tennessee (Chicago, Illinois: H.W. Lochner and Company, and DeLeuw, Cather and Company, 1948), p. V.

in this plan were for a normal twenty-year timeframe. In dealing with the problems of downtown Knoxville, the firms proposed that because "downtown streets are narrow and several of them are on steep grades,"[301] a quick and effective way to better traffic conditions was to inagurate a sound, carefully designed one-way street plan. The one-way street plan for downtown Knoxville in 1948 is virtually the same as the one in effect today. Other improvements to streets in the CBD included a variety of intersection realignments, closed streets and new streets. Figure 61 shows the physical improvements which were proposed for the intersection of Western Avenue/Broadway/Henley Street. Ironically, until Henley Street was widened and realigned to merge with Broadway and Western Avenue, problems with heavy congestion, difficult turning movements and accidents were not nearly as severe. The addition of Henley Street to this intersection created an extremely difficult five-legged intersection with several acute-angled approaches. Also, with the implementation of a system of one-way streets, the firms proposed that traffic be segregated frm the east end of the Clinch Avenue bridge to connect with "through" movements along Church Avenue and the Church Avenue bridge on the eastern side of downtown Knoxville (see Figure 62). This project was never implemented, and as a result, Knoxville suffered for a long time with a major jog in traffic movement in the CBD.

In planning for a system of new expressways, the study revealed that:

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[301] Ibid., p. 3.

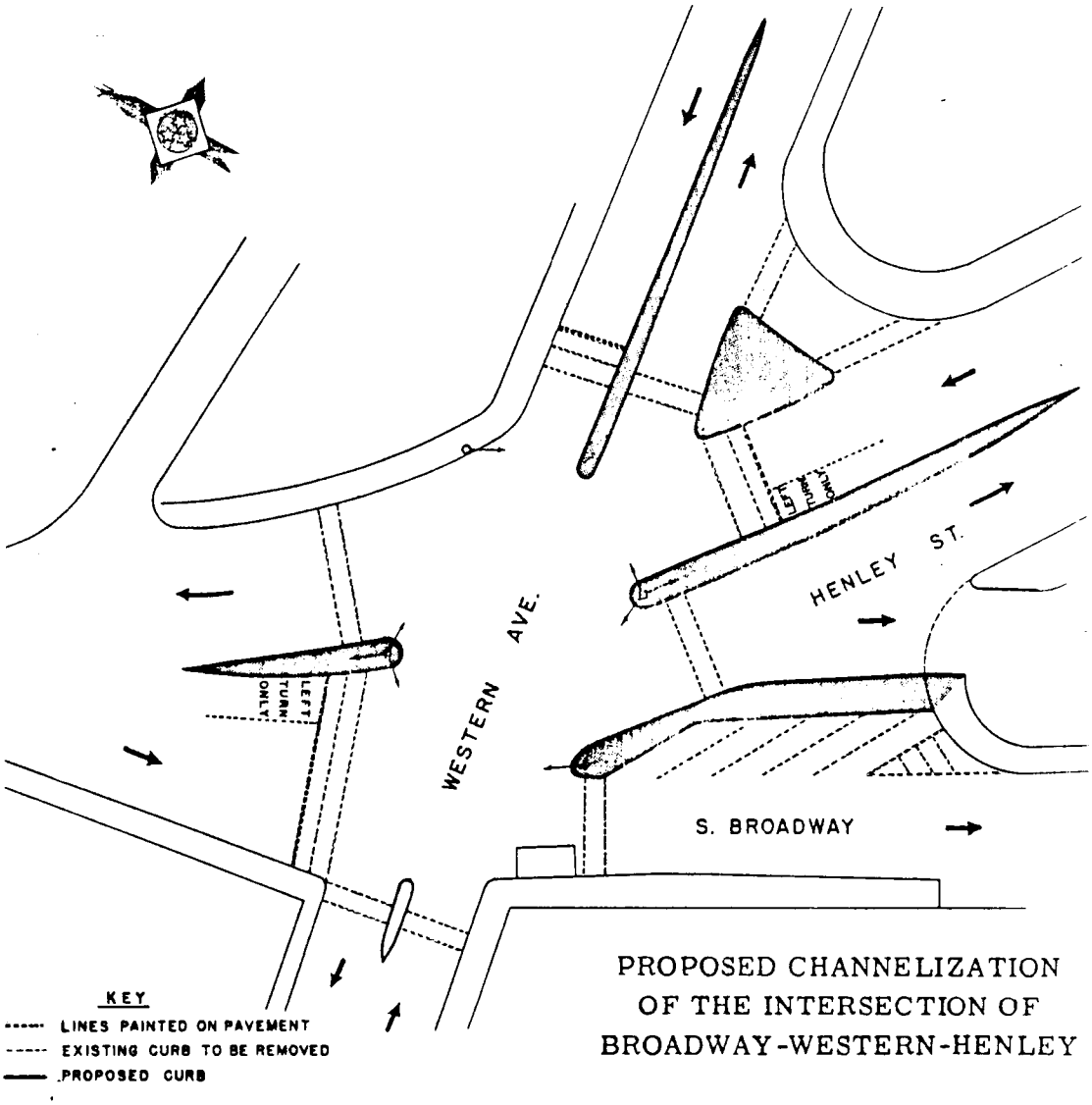


Figure 61. Intersection of Broadway, Western Avenue and Henley Street.

Source: H.W. Lochner and Company, and DeLeuw, Cather and Company, Highway and Transportation Plan, Knoxville, Tennessee (Chicago, Illinois: H.W. Lochner and Company, and DeLeuw, Cather and Company, 1948), p. 7.

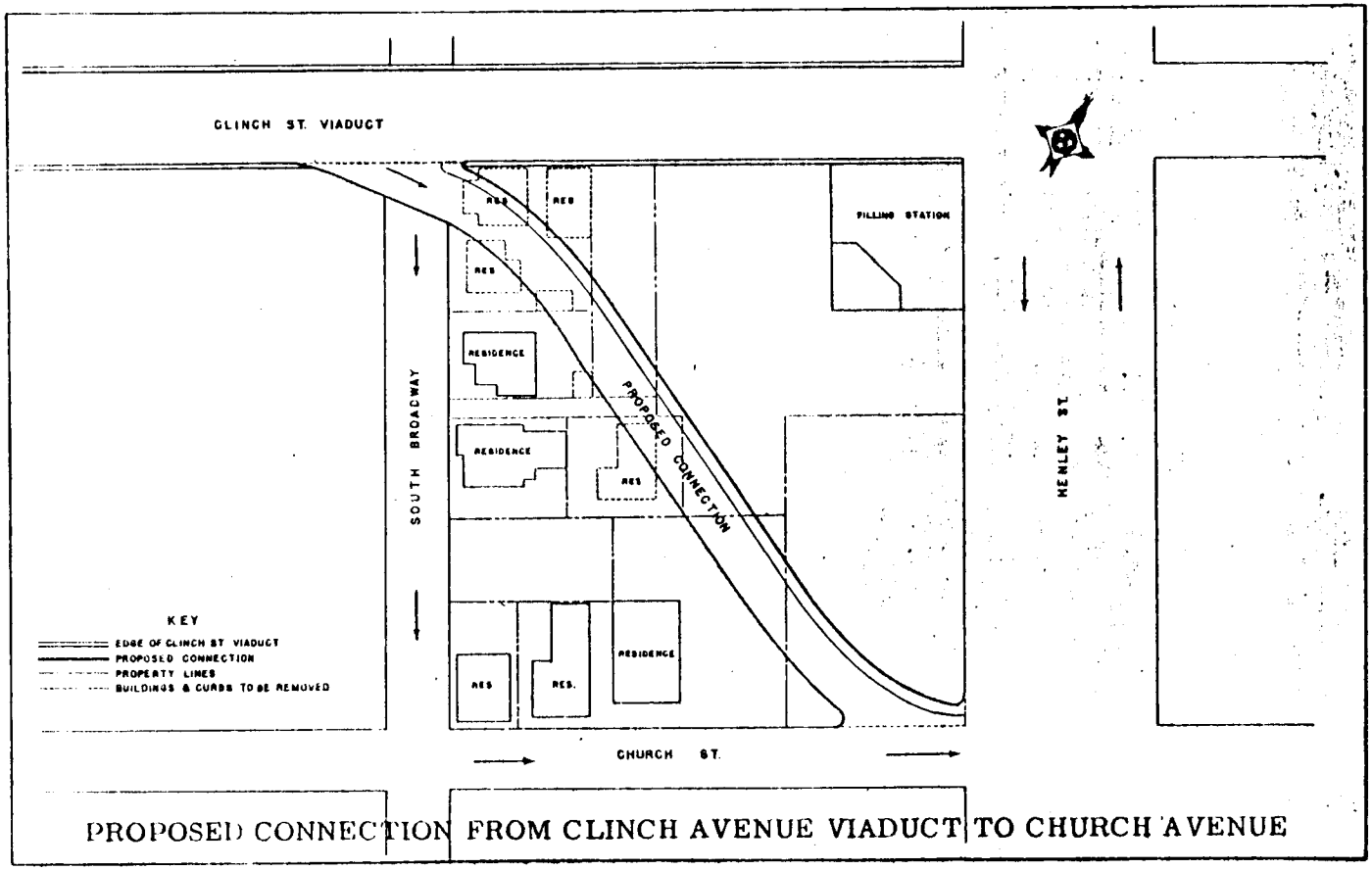


Figure 62. Clinch Avenue/Church Avenue Connection.

Source: H.W. Lochner and Company, and DeLeuw, Cather and Company, Highway Transportation Plan, Knoxville, Tennessee (Chicago, Illinois: H.W. Lochner and Company, and DeLeuw, Cather and Company, 1948), p. 8.

In addition to providing the higher type of trafficways to accommodate the heaviest flows of traffic in the Knoxville area, a system of major streets are needed to distribute traffic to and from the arterial routes, to serve the cross-town and inter-neighborhood movements and to lend the necessary flexibility to the entire trafficway pattern.[302]

In this investigation the costs of vehicles operating over today's highways and streets were compared with the costs of operating over freeways existing theoretically along the lines of the proposed arterial routes. The annual benefits, measured in time and mileage savings resulting from freeway use were weighed against the annual costs of the projects. The costs consisted of the annual amount necessary to amortize the required investment and pay annual interest charges on the capital utilized. The study indicated that freeway construction could not be economically justified along any of Knoxville's arterial routes.

Arterial routes retaining some of the advantages of the freeway but foregoing the more expensive features appears to be the logical plan for meeting Knoxville's major traffic demands.

The freeway features which could be incorporated into the arterial routes where justified are limited access, segregation of local and express traffic and grade separated railroad crossings. The routes so constructed would still have pedestrians, some cross traffic, and left-turning movements at major street intersections--but there only. Between major intersections, freeway-like conditions would prevail. A route so developed is known as an expressway.

Access to the through lanes of the expressway would be confined to major intersections. Paralleling frontage drives would act as collectors of side street traffic and conditions of this traffic to intersections where it could cross the arterial route also act as protection for the express lanes by preventing disrupting streams of local traffic generated by supermarkets, drive-ins, road houses and similar commercial establishments from entering the express lanes. Conversely, local frontage streets would insulate such local activities from the faster and heavier streams of traffic on the express lanes.[303]

This study was innovative in the fact that for the first time a scheduled program of street design and construction projects was described. The projects that were recommended in the 1948 plan were

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[302] Ibid., p. 22.

[303] Ibid., pp. 23-24.

planned to be spread over a twenty-year timeframe and divided into three distinct phases. Of the projects recommended in Phase 1 only two were implemented: the widening of Blount Avenue from Gay Street to Henley Street, and the Magnolia Avenue extension (see Figure 63).

> 1. Magnolia Avenue Extension--From Gay Street to Fort Sanders Avenue. This is the first link in the East-West arterial connection. It would serve as a by-pass, keeping cross-town traffic out of the downtown area and congested Broadway. In connection with the necessary viaduct over the Southern Railroad tracks it might be grade separated additionally from Broadway. From the viaduct west, the route would be developed as a dual highway with paralleling frontage roads.[304]

The only Phase 2 project was implemented was:

> 1. North Arterial Route--New Construction From Oak Avenue Viaduct to Central Pike-- . . . . The route selected, which runs northward along the line of Marion Street, avoids the more expensive features of the route on the east side of the tracks and makes direct connection to Clinton Pike near the city limits of Knoxville. In addition it offers the opportunity for a connection to Oak Ridge Road, providing that traffic with a high type facility for movement to all parts of the urban area. Traffic on this route would make full use of the costly but lightly used Oak Avenue viaduct. The topography at the south end of this artery permits a relatively simple grade separated interchange between it and the east-west arterial connector [Magnolia Avenue extension]. The improvement should be developed as an expressway with four through lanes, a median strip to separate opposing traffic and paralleling frontage roads. Access points for entering and cross traffic have been established at Heiskell, Tennessee [never completed], Oldham, Baxter and Fifth Avenues.[305]

Phase 3 did not contain any projects which were implemented.

In 1950, the Knoxville City Planning Commission undertook its first comprehensive revision of the original 1930 city plan. Using

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[304] Ibid., p. 28.

[305] Ibid., p. 32.

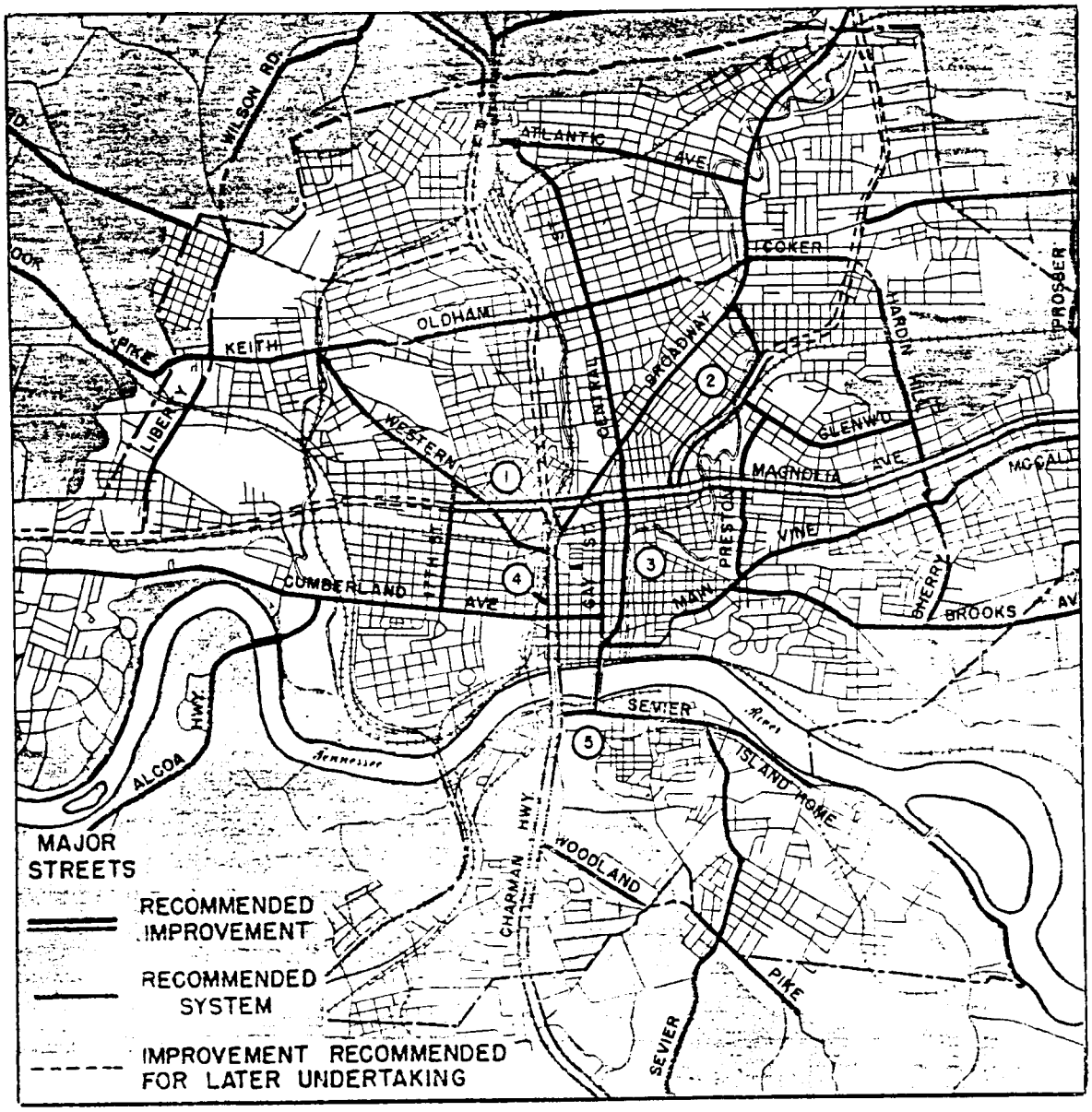


Figure 63. Knoxville in 1948.

Source: H.W. Lochner and Company, and DeLeuw, Cather and Company, Highway Transportation Plan, Knoxville, Tennessee (Chicago, Illinois: H.W. Lochner and Company, and DeLeuw, Cather and Company, 1948), p. 29.

information gathered since the 1930 Knoxville comprehensive plan, the Planning Commission believed that the 1950 plan provided the soundest possible guide for future development of Knoxville. As a "general plan" for Knoxville, the study provided general observations and recommendations for improving Knoxville's street system. For example, "Knoxville's irregular terrain and congested building and street pattern makes finding desirable industrial sites difficult despite many acres so zoned."[306] And,

> The 19th Century street and building pattern does not meet present-day needs. . . . Streets are extremely inefficient for movement of traffic due to . . . too many poor intersections.[307]

> The Central Business District Plan must provide for a loop road to bypass thru traffic around the central business district.[308]

> The automobile, bus, and truck attempting to move on our horse and buggy age street pattern are among the primary causes of our biggest municipal headaches. Congestion--fifty years ago the buggy moved at 10 miles per hour along Knoxville streets. Today the auto designed for 50 miles per hour still crawls at horse and buggy pace. The reason--conventional streets just won't carry the volumes of traffic we have today.[309]

> The framework of the city plan is set by the expressway type of major thoroughfare which circumscribe residential areas and join them to the central business district, large industrial areas, and other main traffic generators in the city.[310]

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[306] City Planning Commission, Knoxville, Tennessee, Planning Knoxville, City Plan Recommended to City Council (Knoxville, Tennessee: City Planning Commission, May 1951), p. 4-2.

[307] Ibid., p. 5-6.

[308] Ibid., p. 5-7.

[309] Ibid., p. 8-1.

[310] Ibid., p. 8-7.

Without providing specifics as to the general location of the major thoroughfares, the plan provided definitions explaining the hierarchy of streets which would be developed in Knoxville.

> 1. Major Thoroughfares--A primary transportation artery which connects the focal points of primary traffic interest within the city, between communities and outlying areas. These should be developed as expressways or parkways with full or partial control of access and with grade separations at selected intersections.[311]
>
> 2. Secondary Thoroughfares--A secondary transportation route which serves to connect the lesser important focal points within the city and with other communities in outlying areas. These are through streets with intersections at grade. Speed of traffic as maintained by alignment and stop signs on all intersecting streets. Where existing through streets are incorporated in the City Plan, direct access to abutting property will probably be retained. Such secondary thoroughfares as are constructed in the future should be of the limited access type.
>
> 3. Neighborhood Feeder Street--A service street circumscribing the residential area or connecting residential streets to neighborhood facilities and secondary or major thoroughfares. Those are through streets with intersections at grade and partial limitation of access to abutting property, serving only neigborhood traffic.
>
> 4. Residential Service Street--A local street providing direct access to residential structures and connecting them to the neighborhood feeder street.[312]

In July 1951, the City of Knoxville finally began construction of the first expressway in the city. Following the design recommendations from the 1948 Highway and Transportation Plan, the City of Knoxville contracted for the completion of the Magnolia Extension Expressway. The Magnolia Extension Expressway was designed to run

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[311] Ibid.

[312] Ibid., p. 8-8.

from Magnolia Avenue to approximately Twenty-fourth Street, a few blocks farther than originally called for in the 1948 plan.

In October 1951, the Knoxville Housing Authority authorized the clearance of all housing within an area defined as the Magnolia Extension Redevelopment Area (see Figure 64). This was done in order to provide land for warehouse and light industrial uses, and to assist in the completion of the Magnolia Extension Expressway through the northern half of the redevelopment site (see Figure 65).[313] According to the eleven-page Magnolia Extension Redevelopment Plan, one of the major problems that the Knoxville Housing Authority was trying to eliminate within the redevelopment area was "a street layout designed for the nineteenth century."[314]

> Revision of the existing street layout within the Project Area is proposed with the aim of eliminating unnecessary streets, alleys, and intersections. This will facilitate movement within the warehouse district, develop larger blocks, and make available for productive use the right-of-ways which will be closed.
>
> As shown on . . . this Redevelopment Plan proposes that the following streets and alleys be closed within the Project Area: Tulip Avenue, Atkin Street, Heins Street north of Hannah Avenue, Euclid Avenue south of the expressway, North Street, Cowan Street south of the expressway, Wendlandt Alley, Curton Alley, Back Alley, Hamilton Alley, Travis Alley, John Street and the alley intersecting therewith; and in addition those alleys which are situated between Tulip and Hannah Avenues. . . .
>
> . . . . . .
>
> Within the Project Area, certain frontage roads accessory to the Magnolia Extension Expressway are included in the contract for the construction of the first section of the expressway. These are: 1) extension of Euclid Avenue from its intersection

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[313] Knoxville Housing Authority, Magnolia Extension Redevelopment Plan (Knoxville, Tennessee: Knoxville Housing Authority, October 1951), p. 1.

[314] Ibid., p. 2.



Figure 64. Magnolia Extension Expressway.

Source: Knoxville Housing Authority, Magnolia Extension Redevelopment Plan (Knoxville, Tennessee: Knoxville Housing Authority, October 1951), inside cover.

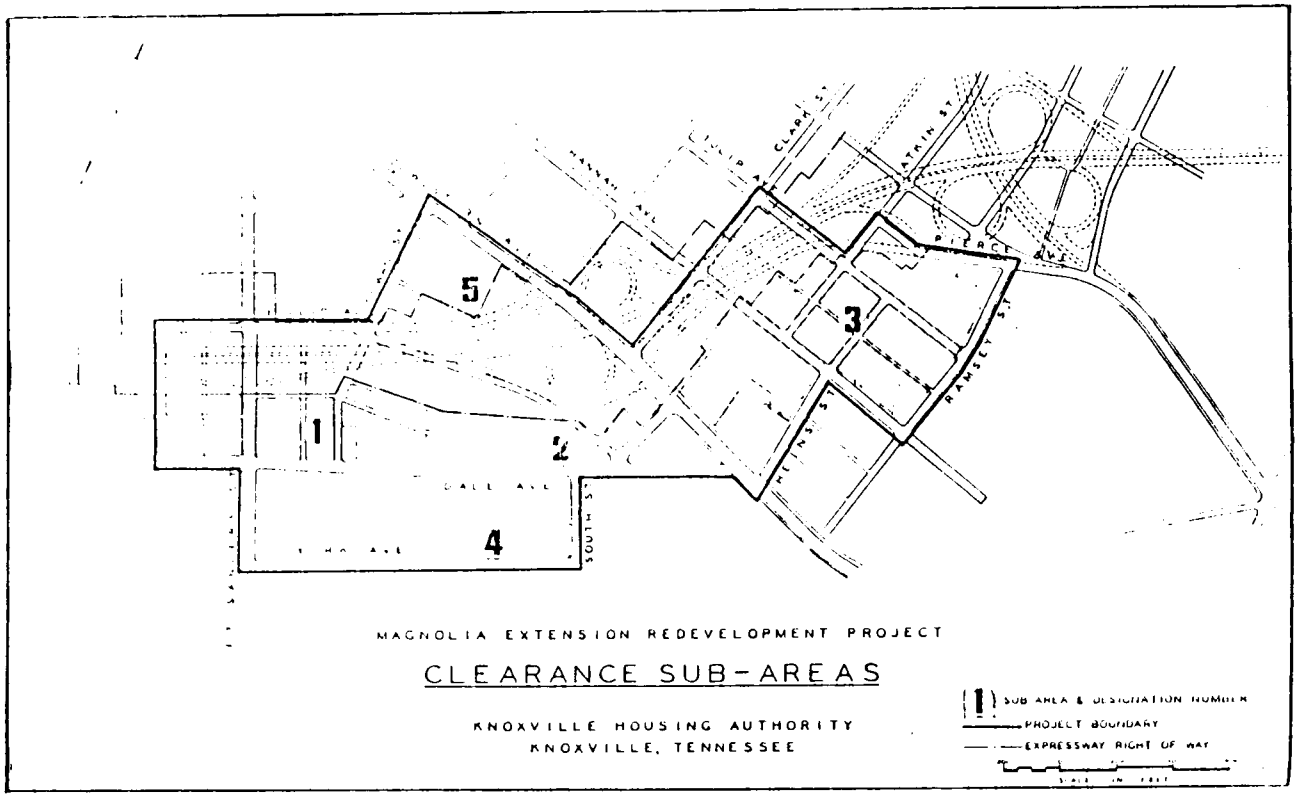


Figure 65. Magnolia Extension Clearance Plan.

Source: Knoxville Housing Authority, Magnolia Extension Redevelopment Plan (Knoxville, Tennessee: Knoxville Housing Authority, October 1951), p. 1.

with Cowan Street to Western Avenue; and 2) connection between Western and Pierce Avenues on the south side of the expressway.[315]

Two important factors influenced the ultimate design and layout of the Magnolia Extension Expressway in Knoxville. First, due to a sagging local economy at the time of construction, downtown merchants and business men pushed for the construction of this facility to increase the accessibility of downtown Knoxville. Because of its relative isolation from the rest of the community, this project was seen as being crucial to maintaining a competitive edge from the rest of the newer "suburban" shopping centers. Second, this facility was hailed as Tennessee's first freeway by the media and was considered a landmark development. Unfortunately, due to the eagerness of designing the state's first high-speed, limited-access roadway, local and state traffic engineers and planners did not have the necessary experience to properly design a freeway for use over a twenty-year period. Problems with the design of the expressway became apparent later as the roadway was dubbed "Malfunction Junction" by local critics. For example, the facility was originally designed to carry local traffic (i.e., automobiles, and not large trucks and tractor-trailers) and thus the turning radii of the cloverleafs were designed much smaller than really needed. Given that most of the "interstate" traffic used U.S. 70 (Kingston Pike and Magnolia Avenue), this was not considered a problem until later when the expressway was linked to the rest of the new Interstate system. Another significant problem with

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[315]Ibid., p. 5.

the design of the expressway was the narrow spacing of the interchanges, with on- and off-ramps spaced too closely together. Also, the expressway's design and layout did not really cure the ills of a poorly designed surface street system but managed to separate them into areas north and south of the expressway. A further detailed analysis of this area's street system will be conducted in the case study investigation.

Through the mid-1950's, Knoxville's character as a city was beginning to change from a town dependent upon a fine public transit system to one falling in love with the automobile. Travel to other employment centers such as Oak Ridge and Alcoa assisted Knoxville's desire for the completion of a system of expressways and major thoroughfares. Knoxville was also experiencing its first real growth in the suburban fringe around the city. These trends were described in Hammer and Company's study on the Central Business District:

> Like other U.S. metropolitan areas, Knoxville's growing population is rapidly spilling over into the suburban areas adjacent to the central city. Prosperity and the automobile have put modern America on wheels. A new pattern of living is developing which each year sees a greater proportion of the total population living in pleasant new subdivisions miles from the heart of the central city.
>
> Knoxville's suburban growth is taking place in Knox County. . . . Knox County outside of Knoxville has increased its population by nearly 27,000 since 1950--two and a half times as great a gain as within the City of Knoxville.[316]

While Knoxville was enjoying the advantages of a suburban lifestyle, businessmen and merchants were attempting to thwart the

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[316]Hammer and Company, Knoxville's Central Business District (Atlanta, Georgia: Hammer and Company, 1955), p. 5.

effects of decentralization in the downtown area. Hammer and Company felt that one of the causes of Knoxville's decentralization problems was the poor layout of the street system in the CBD.

> Much of the street and sidewalk pattern is also obsolete in terms of modern traffic. Many traffic lanes are too narrow for modern vehicles. Many streets are not through, making it necessary for traffic to jog around sharp corners.[317]

The study also revealed that business downtown was suffering from:

> . . . increased automobile ownership, general prosperity, traffic congestion that slows down transit service, removal of transit buses from the street as patronage declines--and the result is an ever-increasing congestion on Knoxville's downtown streets.[318]

These factors coupled with the limited numbers of "gateways" in the Central Business District emphasized the need to complete the planned system of expressways and major thoroughfares. During the writing of the report, the Magnolia Extension Expressway was nearing completion. Hammer and Company said "The full effect of this improvement upon downtown traffic will not be felt until the connecting west leg is pushed outward to tie into Kingston Pike and the Alcoa Highway."[319] Discussion of the North-South expressway consisted of:

> Agreement has been reached on the route of the north artery which will follow the railroad right-of-way north to tie in with

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[317] Ibid., p. 28.

[318] Ibid., pp. 37-38.

[319] Ibid., pp. 43-44.

> Clinton Pike beyond the city limits. The construction of this route is likely to be several years off--its effect will be primarily to relieve Central Avenue, but it will also free up some downtown traffic as part of the overall bypass system.[320]

Hammer and Company concluded its exhaustive analysis on the circulation problems of downtown Knoxville by stating that:

> Knoxville's traffic improvements up to the present time have primarily been improvements in the direction, channelization, and flow of traffic rather than improvement in street capacity and construction of new arteries. Although well-conceived and effective, these improvements have for the most part been palliatives. Faced with increasing volumes of traffic and a relatively fixed street capacity, this type of improvement program will not be able to meet the trends in the next few years.
>
> The proposed new arterials will be of great benefit in diverting through traffic from the Central Business District. However, the timing of their construction is still some way off in the future. In the meantime, the Central Business District faces a critical situation of mounting congestion on its downtown gateways and streets.[321]

In a later related proposal to improve access to the central part of Knoxville, City Planning Commission Director Joe B. Whitlow developed the concept of an expressway loop around the Central Business District. The loop was to be formed by Interstate-40 on the north, with the east leg of the loop to be located in First Creek, the west leg in Second Creek, and the south leg along the Tennessee River. Additional connections on the south were to extend west along Neyland Drive and east along the river. Mayor Jack Dance supported this

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[320] Ibid., p. 44.

[321] Ibid., p. 45.

proposal and reached agreement on the concept with the Tennessee State Highway Department.[322]

While Knoxville's businessmen were concentrating their efforts on getting expressways built in the city, the citizens of the Fountain City area were preparing to decide whether to incorporate as a separate township or push for annexation by the City of Knoxville. In 1955, a group of citizens named the Fountain City Study Group, initiated a study weighing the costs and benefits of annexation versus incorporation. Until 1935, no organization was officially responsible for the design and layout of Fountain City's street system. The Knox County Planning Commission assumed responsibility over the town's street planning functions in 1935 but never produced a separate road plan for Fountain City. The only significant street proposal made by the Planning Commission for the area consisted of a belt line road running adjacent to Dutch Valley Road. The proposed belt line would later be developed as the Interstate-640 loop. The study concluded that regardless of whether Fountain City incorporated as a separate city or was annexed by the City of Knoxville, a major street plan would be needed to handle the rapid growth which had been occurring in the area.

> A major street plan for Fountain City is especially needed. This would take into account the direction and type of future expansion as well as access to and parking space around existing residential, commercial, industrial and recreational areas. Since most of Fountain City's working population commutes daily to Knoxville, the street system should be designed to handle this

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[322]Lucile Deadrick, op. cit., p. 130.

> city-bound traffic, and should be coordinated with traffic flow within the city of Knoxville. Street planning in Fountain City would include designation of through streets of adequate width, alignment, and surface. There are many instances where little more than country lanes have become traffic arteries providing the only access to large new subdivisions, without changes in the road itelf. A road plan would anticipate future traffic load and avoid expensive road building later on. . . .
>
> . . . . . .
>
> planning for the whole Knoxville metropolitan area seems desirable.[323]

Two major events occurred in 1956 which have affected street planning and design in Knoxville since that time. First, with the passage of the Federal-Aid Highway Act, Knoxville was guaranteed a portion of the Interstate highway pie, and this would aid the completion of the expressway system already planned for the city. Construction of the Interstate highways did not begin immediately in the area, however, because new planning and design studies were conducted first. Aiding those studies was the merger of the City Planning Commission and the Knox County Planning Commission, forming the present Knoxville-Knox County Metropolitan Planning Commission (MPC). This merger provided a means of planning for and carrying out street and highway design projects for the city of Knoxville and Knox County.

In 1958, Mid-South Engineering Company was contracted by the City of Knoxville to prepare a plan for the proposed downtown loop. This study was a follow-up to earlier ideas presented by the City Planning Commission and Knoxville Mayor Jack Dance. Figure 66 shows

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[323]Fountain City Study Group, Fountain City, Tennessee: A Closer Look (Fountain City, Tennessee: Fountain City Study Group, October 1955), p. 28.

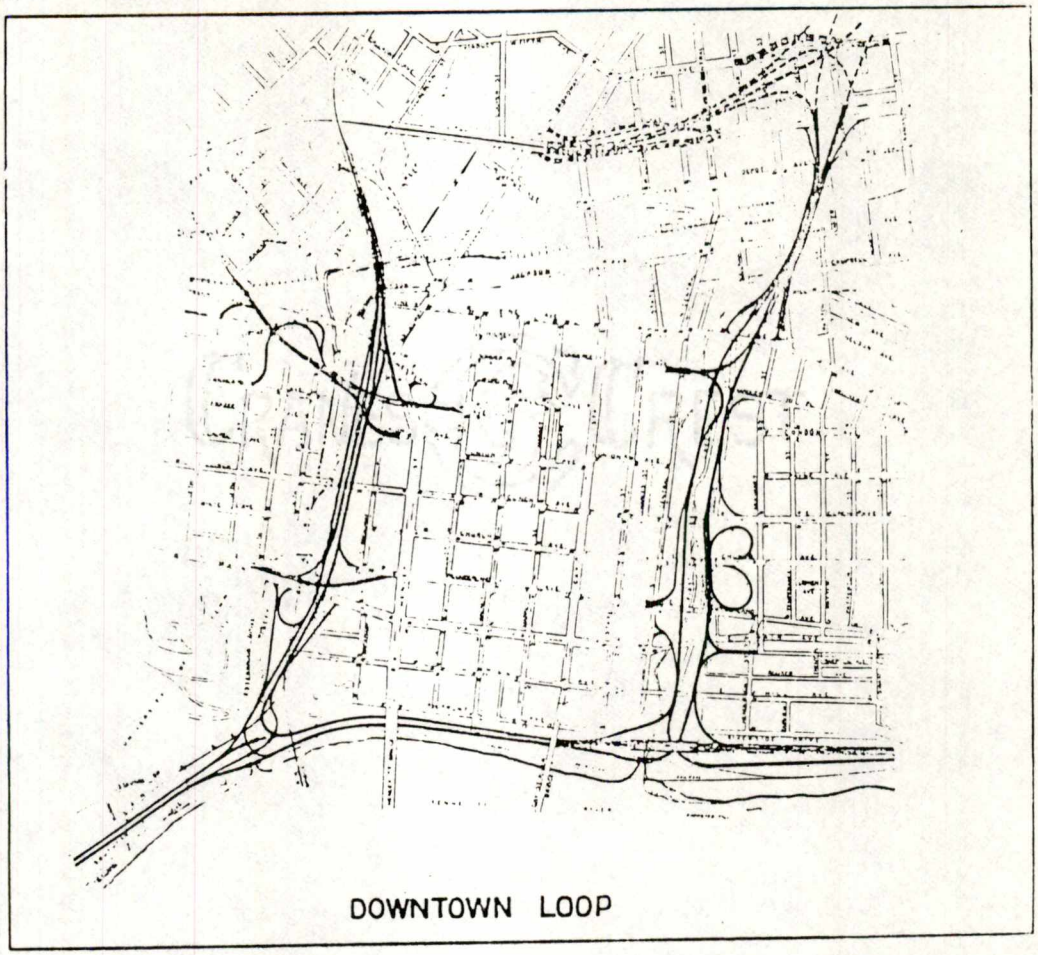


Figure 66. Downtown Loop.

Source: Mid-South Engineering Company, Knoxville Downtown Loop (Knoxville, Tennessee: Mid-South Engineering Company, March 1958), p. 7.

the overall street plan for the project. Unfortunately, the firm treated the loops as a separate system, and as a result, the loop and the other CBD streets would have functioned poorly. Plans were inadequate for the loop, and further design work was required. This job was later given to Wilbur Smith and Associates. The only part of the plan which was implemented was the interchange with Interstate-40 and Magnolia Avenue, north of Vine Avenue, in the top right corner of Figure 66. The east leg of the loop from Interstate-40 to Vine Avenue was completed in the late 1960's, and the remainder of the leg in 1973. The south leg of the loop and Neyland Drive were completed in 1974.[324] The west leg of the loop was never built.

The last major study of Knoxville's street and highway system during the 1940's and 1950's was conducted by Wilbur Smith and Associates, and the Knoxville-Knox County Metropolitan Planning Commission in January, 1959. Their study, Metropolitan Knoxville Traffic and Circulation, was intended to provide a foundation for future comprehensive planning, particularly the Major Road Plan of 1960. The study was also performed because of "the necessity for a re-evaluation of the 1948 study by the tremendous, unforeseen growth which has occurred in the County in the past ten years."[325] Knoxville's growth plus the inevitable coming of the Interstate

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[324]Lucile Deadrick, loc. cit.

[325]Knoxville-Knox County Metropolitan Planning Commission, Metropolitan Knoxville Traffic and Circulation (Knoxville, Tennessee: Knoxville-Knox County Metropolitan Planning Commission, January 1959), p. 4.

highway system prompted local officials to take a hard look at the area's street and highway system.

> Perhaps the greatest impact on the major road system, however, will be the development of the interstate expressways. These new facilities will create a rigid framework which will have a profound effect not only on future road patterns, but also on all future development.[326]

While the study was oriented toward maximizing the efficiency of traffic movement in Knoxville with the latest techniques in traffic control (i.e., signage, signalization, pavement markings, one-way streets, etc.), it also dealt with the problems with the layout of the street system. The study focused on a number of poorly aligned intersections, offering a variety of methods to correct the problems. Unfortunately, the report did not specify how these improvements could be made, leaving these problems to the major thoroughfare plan which was programmed to be completed by MPC in 1960.

One interesting section within the study was the analysis of the 1945 and 1948 major street plans for Knoxville. Given that the 1945 study was the "latest" adopted thoroughfare plan for Knoxville, the 1959 analysis provided a detailed progress report on those projects and proposals made in 1945 and 1948.

> In light of the unexpected urban growth that has occurred subsequent to the studies and also because of the profound effect that the Federal Interstate Highway System will have on the major traffic patterns of the area, this section attempts to evaluate

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[326] Ibid., p. 5.

these studies in light of these forces and point up the urgent need for revision of the Major Road Plan for Knoxville-Knox County.[327]

Several interesting points were brought out which helped influence the plan recommendations of future major street plans for Knoxville and Knox County. For example, from the 1945 and 1948 plans these points were made:

> Although the northeastern sector was considered the most logical for future development, in actuality the Kingston Pike sector has received the largest portion of the fringe area population growth. An appreciable amount of growth was expected in the Bearden area, but urban development in the West sector has far surpassed that anticipated, due to the development of West Hills and Northshore Drive, and the expansion of the Westmoreland area.[328]

> The overly-conservative population estimates are inherently reflected in the (traffic) flow projections, as indicated by the present volumes, most of those which exceed those anticipated for 1970.[329]

> Of the three new highways suggested, two, the North and the West, have been incorporated into the Federal Interstate System with a subsequent raising of design standards to include controlled access. The need for the third proposed arterial route, to parallel Broadway, has been substantially lessened by other aspects of the new Federal System. Although major collector routes will still be needed in this area, Magnolia Avenue was considered a major artery in 1948, capable of handling all traffic volumes from the East for years to come, it has since been found inadequate. To carry the great volumes of traffic, therefore, a limited access section of the Federal System will be constructed paralleling Magnolia.[330]

> One traffic demand pattern--that for a belt route system--was not met in these initial proposals, but has been partly satisfied

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[327] Ibid., p. 71.

[328] Ibid., p. 75.

[329] Ibid., p. 76.

[330] Ibid., p. 79.

> with the addition of the Dutch Valley Loop to the freeway system. Before the final location of this loop is determined, however, further study should be made of population location, particularly in the northeastern section and anticipated traffic flow therefrom.[331]

F. THE WESTWARD MOVEMENT, 1960-TODAY

During the 1960's, 1970's and the early 1980's, Knoxville's physical form changed once again. Two factors were primarily responsible for this change: 1) the massive construction and reconstruction of the Interstate highways through and around Knoxville, and 2) Knoxville's emerging interest to live in the suburbs of Knoxville or Knox County. These two factors are directly related to each other and have, simultaneously, influenced Knoxville's present configuration. As in most urbanized areas, a significant portion of Knoville's growth occurred to the west of the city's 1917 city limits line.

> The planners apparently did not anticipate the power of Interstate-40 to attract residents into the west part of the county. . . . At any rate, the Fountain City area virtually ceased to grow after its annexation in 1962, and development west of the city proceeded at an extremely rapid rate in the unincorporated areas. In the decade of the 1960's, 65 per cent of the net population increase that took place in Knox County occurred in the western sector, with a trend toward heavier and heavier concentration of growth in this part of the county.[332]

Planning for the construction of the Interstates and the growth occurring in the suburbs of Knoxville became a very important activity during Knoxville's last period of history. Like the 1940's

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[331] Ibid., pp. 79, 81.

[332] Lucile Deadrick, op. cit., p. 126.

and 1950's, many traffic and major thoroughfare studies were completed to aid this growth and development in Knoxville. Following up on the recommendations of the 1959 study on metropolitan Knoxville's traffic and circulation, the Metropolitan Planning Commission for Knoxville and Knox County developed the Major Thoroughfare Plan. This plan was designed to refine previous plans and proposals, and to make sure that the design of future streets and highways in the total system would be adequate for the next twenty years.

> The necessity for thoroughly restudying and revising major thoroughfare plans for this area is quite obvious. None of the previously prepared plans are adequate in scope and coverage in relation to the present urbanizing areas of Knox County. A plan is needed which will provide for future circulation needs of the entire City and County. Existing plans are inadequate in the projections of population growth upon which their recommendations to be far too conservative and, in addition, the pattern of urban growth has been much more sprawling and dispersed than anticipated by these plans.[333]

> The single most important factor necessitating the restudy of the local major street system is the development of the Federal Interstate Highway System. . . . This high-volume, controlled-access system will have a profound impact upon the patterns of traffic movement within the urban area, as well as the pattern and direction of urban growth itself. The changes in relative accessibility brought about by this expressway system will have far reaching effects on the redevelopment and changes in use of present developed areas and the extent and direction of new urban growth into present open sections of the County. The function of many existing major streets will have to be changed in order to connect with expressway interchanges. It is readily apparent that the expressway system will be the backbone of the future major street system for this area.[334]

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[333]Knoxville-Knox County Metropolitan Planning Commission, Major Thoroughfare Plan, Knoxville and Knox County (Knoxville, Tennessee: Knoxville-Knox County Metropolitan Planning Commission, October 1960), p. 1.

[334]Ibid., p. 2.

The study also refined the classification of streets by their function and development standards. The study defined four types of streets: 1) Interstate Highways, 2) Major Thoroughfares, 3) Secondary Thoroughfares, and 4) Land Service Streets. The hierarchy previously mentioned is equivalent to the hierarchy used today: 1) Interstate Highways, 2) Arterials, 3) Collector Streets, and 4) Local Streets. The standards presented in the study are also identical to those used by traffic engineers and planners today. Of the categories identified in the Major Thoroughfare Plan, only Land Service Streets contained any specific recommendations as to the layout of those streets. "The layout of these streets should be designed to discourage fast through traffic, and T-intersections are preferable."[335] All of the other categories were relatively general, allowing for the flexibility of application in the Knoxville area. The study did present, graphically, the relationship between the four classifications of streets when arranged in an orderly, intelligible pattern (See Figure 67). This arrangement of streets for suburban Knoxville would become the working model for the area for the next twenty-three years.

The Major Thoroughfare Plan for Knoxville and Knox County also contained some interesting concluding remarks about the overall layout of the area's street system.

> Existing principal traffic routes within the Knox County urban area form essentially a radial pattern. This pattern of streets serve well traffic destined for or originating in the central area but leaves much to be desired for traffic moving cross-town or

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[335] Ibid., p. 9.

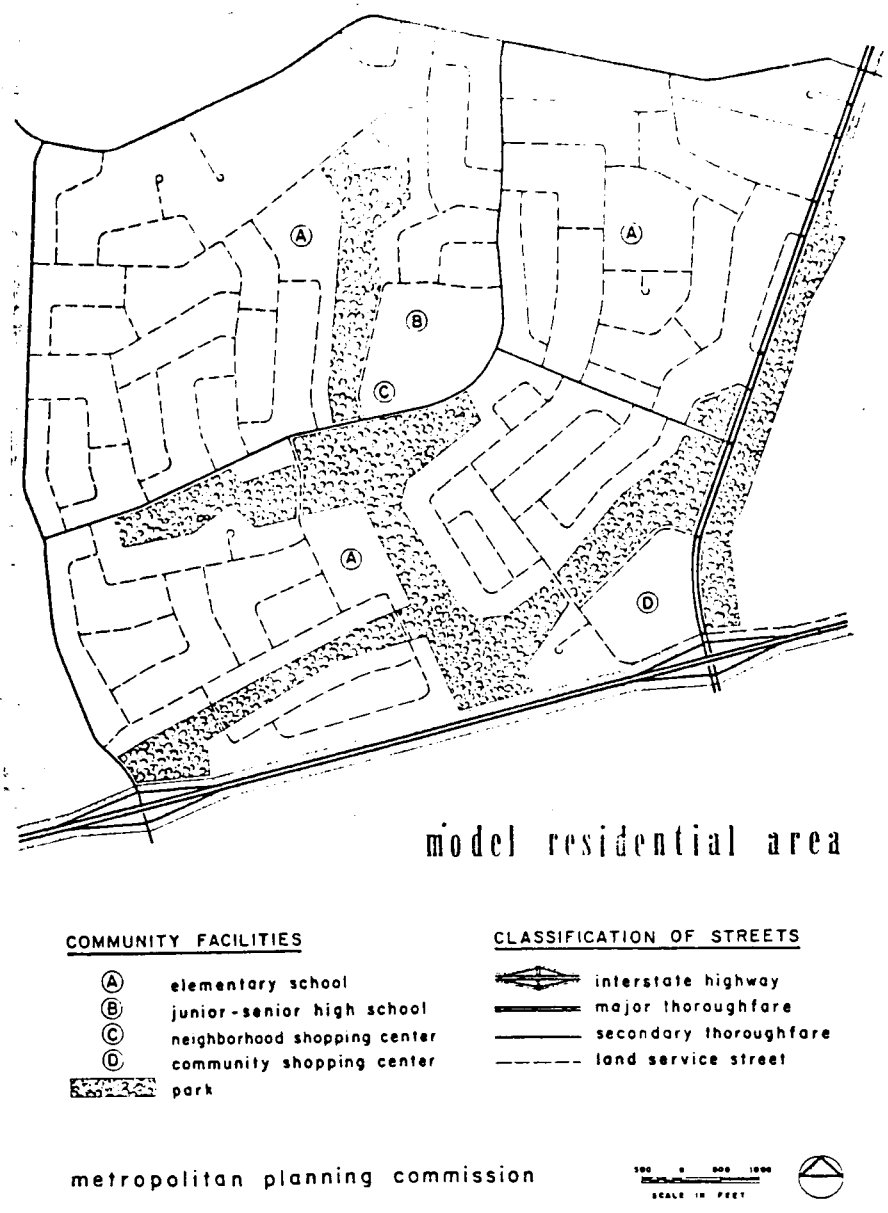


Figure 67. Model Residential Area.

Source: Knoxville-Knox County Metropolitan Planning Commission, Major Thoroughfare Plan, Knoxville and Knox County (Knoxville, Tennessee: Knoxville-Knox County Metropolitan Planning Commission, October 1980), p. 13.

> from one outlying area to another. Circumferential and cross-town routes either do not exist, or follow an obscure and winding pattern. Traffic movements exclusively between outlying areas of the city must nevertheless go in and out of the central area to reach their destination, thus adding to congestion on already inadequate streets.[336]

The solution to these problems would be the adoption and implementation of the plan, providing "an improved system of radial routes, based largely upon existing streets, with a strong pattern of circumferential streets."[337]

In 1962, while the planning and design of the Interstate highways were occurring in Knoxville and Knox County, the City of Knoxville undertook expansion once again, annexing a tremendous amount of peripheral land into the city proper. Most of this annexed land included newly-built subdivisions and communities, including the town of Fountain City. The street patterns in these annexed areas typically featured the latest concepts in subdivision design such as curvilinear streets, loop streets, cul-de-sacs, and a definite hierarchy of streets throughout. Although these subdivisions were usually adequately designed when examined individually, they often did not work in aggregate because the total street patterns and systems were not well planned or not planned at all. As a result, heavy volumes of traffic were traveling on local streets leading to the arterials or Interstate highways. While these streets were properly designed as residential streets in pattern, in function they did not

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[336] Ibid., p. 16.

[337] Ibid.

work as collector or arterial-type streets. Morrell Road, Weisgarber Road, Papermill Drive, and Bridgewater Road are prime examples of these problems. Part of the fault can be traced to lax zoning and subdivision regulations that were adopted.

> The physical form of much of what is now Knoxville was, to a degree, determined by a Knox County Court resolution approved in 1946. It established standards for subdivisions and unincorporated sections of the county that now make up the vast majority of the territory of Knoxville. Again in 1956 the most active developers of new residential subdivisions agreed to subdivision standards when the Knoxville Home Builders Association with no curbs, gutters, or storm sewers. Residential areas that were developed according to these standards, in most cases without central sewer systems, became part of the city by annexation in 1962.[338]

Once again, Knoxville assumed the responsibility of correcting vast numbers of poorly designed streets and street patterns by annexing a large tract of land.

A year later, in 1963, the Knoxville-Knox County Metropolitan Planning Commission completed a four-volume comprehensive transportation study for the entire county. This study outlined the basic status of the street and highway projects occurring at the time, and identified some of the major problems with the entire system but did not offer solutions or a methodology to improve those conditions.

At the time of the study, Interstate-75 North, assuming the North-South Expressway (Marion Street Extension) facilities, was complete to Clinton Highway; Interstate-40 East was under construction; and Interstate-40 West was complete from the Loudon County line

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[338]Lucile Deadrick, op. cit., p. 125.

to Papermill Drive as well as from Interstate-75 to Seventeenth Street, however, from Seventeenth Street to Papermill Drive, this section was still under construction.[339] The alignment of these Interstate facilities basically followed the paths of previously planned or constructed expressways through Knoxville. In their attempt to reduce the total cost of building the Interstate highways through Knoxville, the United States Bureau of Public Roads officials approved of the use of the poorly designed Knoxville expressway system for Interstate travel. These facilities were notably deficient in their alignment and function but were used nonetheless. Much of the blame for this mistake can be placed on the shoulders of local elected officials and businessmen who wanted Interstate traffic brought to downtown Knoxville to help support an economically depressed CBD. Because of the politics involved with the planning and design of the Interstate highways in Knoxville, it should be noted that Interstate-75 had one of the largest jogs of any highway in the United States. Interstate-75 continued to the south some twenty miles away in Loudon County. This jog still exists in Knoxville although it was reduced some with the eventual construction of Interstate-640 around the city.

A more sensible approach to the planning and design of Knoxville's Interstate highways occurred at Interchange Number 4,

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[339] Knoxville-Knox County Metropolitan Planning Commission, Knoxville-Knox County Comprehensive Transportation Study, Current Street Use Classification (Knoxville, Tennessee: Knoxville-Knox County Metropolitan Planning Commission, May 1963), pp. A-1 to A-3.

where Interstate-40 met the extended Alcoa Highway. Officials from the Metropolitan Planning Commission met with the principals of Rohm and Haas chemical company to discuss the company's future needs for industrial land. The original alignment called for Interstate-40 to bisect the company's vacant property, leaving Rohm and Haas with land that was not contiguous with the rest of the operation. As a result of those meetings, Interstate-40 was realigned northward to allow Rohm and Haas the flexibility to expand within their own defined boundary. Although this adjustment disrupted the gridiron street pattern for the area, the benefits of increased accessibility and flexibility for the plant may have offset additional problems that were created.

Volume III of the Knoxville-Knox County Comprehensive Transportation Study examined the locations and causes of fatal traffic accidents within Knoxville's city limits. According to the study, "During 1962, the National Safety Council reported 5.2 persons killed per 100 million miles traveled. In Knox County, an estimated 8.3 persons per 100 million miles traveled were killed during the same year."[340] Much of the blame for those terrible statistics can be placed on the overall design of Knoxville's streets and intersections.

> Street design characteristics bear a direct relation to both the number and type of accidents. This relationship is affected, to a marked degree, by volume of traffic. Most intersections contain obvious deficiencies that result in their being classified "accident prone," while others may seem to be "harmless" to the

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[340] Knoxville-Knox County Metropolitan Planning Commission, Knoxville-Knox County Comprehensive Transportation Study, Traffic Accidents (Knoxville, Tennessee: Knoxville-Knox County Metropolitan Planning Commission, November 1963), p. 8.

> casual observer. Both types can and should be improved, not only with all types of traffic control measures but with physical design changes as well.[341]

Of the forty-two highest accident prone intersections identified in the study, the intersection of Henley Street at Western Avenue ranked number one with thirty-eight accidents in a seven month period.[342] This acutely-angled intersection had more than a nine accident lead in this short period of time, demonstrating the difficulties with the design of this intersection.

The information which was documented in the 1963 Comprehensive Transportation Study for Knoxville and Knox County was used by Wilbur Smith and Associates in 1964 to plan for the highway and transportation needs for the next twenty years. This plan would replace the Major Thoroughfare Plan of 1960 and act as the official plan for the area. The study provided an exhaustive amount of information on the existing transportation facilities of Knoxville and Knox County but did not mention the street patterns or systems. While recognizing that "The topographic and physical conditions of the Knoxville area prevent continuity of many routes; consequently 'Tee' intersections and offsets on street routings have resulted,"[343] no other mention of the state of condition regarding the area's street and highway system was made.

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[341] Ibid., p. 11.

[342] Ibid., p. 12.

[343] Wilbur Smith and Associates, Travel Patterns and Highway Transportation Plan (Columbia, South Carolina: Wilbur Smith and Associates, 1964), p. 26.

In 1968, barely a decade after the completion of the Magnolia Extension Expressway, the City of Knoxville hired Wilbur Smith and Associates to prepare a set of plans to improve the set of interchanges along Interstate routes 40 and 75, between Seventeenth Street and Fifth Avenue. This study marked the beginning of an era of street and highway improvements for Knoxville and Knox County.

Despite receiving considerable recognition in being named an All-American City in 1963, the city of Knoxville was more commonly known as the home of Malfunction Junction. As previously discussed, Malfunction Junction was the poorly designed interchange connecting Interstate routes 40 and 75 in the northwest portion of the Central Business District. Wilbur Smith and Associates summarized the problems of the highway as thus:

> The points of critical restriction frequently result in a complete breakdown of traffic flow during peak travel periods. This condition is primarily attributed to current peak-hour traffic volumes exceeding the capacity limits of some existing roadway sections. However, traffic operating characteristics of ramp ingress and egress also restrict traffic movements during off-peak travel periods largely as a result of substandard weaving and merging conditions.[344]
>
> Another significant contributor to excessive restrictions in traffic flow is the substandard distance between ingress and egress points where large volumes of traffic enter and leave the main roadway concurrently. Extreme limitations of ramp approach lanes cause a significant amount of traffic weaving and merging on the through lanes of the expressway.[345]

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[344]Wilbur Smith and Associates, Traffic Study and Functional Design East West Expressway: Fort Sanders Interchange to I-75 Interchange (Knoxville, Tennessee: Wilbur Smith and Associates, September 1968), p. 3.

[345]Ibid., p. 4.

Reflecting on the roadway's original intent and subsequent design, Wilbur Smith and Associates provided an interesting description of the facility's problems by stating:

> The existing East-West Expressway facilities within the study limits were constructed in 1954-55. The standards and criteria utilized for the existing roadway and interchanges predated those currently established for the Interstate Highway System. The criteria utilized for expressway design prior to the advent of the Intrstate Highway criteria provided for ingress and egress at most all locations where traffic demands existed. This resulted in a close spacing of interchange points which often necessitated the development of small loops and short ramps. With significant increase in traffic usage in recent years, many movements provided on the expressway currently exceed the ramp capabilities.[346]

The design plan called for the total reconstruction of the entire roadway under study. Many of the ideas and plans presented in the study were later implemented during the massive reconstruction of the Interstates prior to the 1982 World's Fair. Wilbur Smith and Associates also made important recommendations on the design and function of the surface streets surrounding and affecting the project area. Many of these proposals were also later implemented during Interstate reconstruction in Knoxville. The ideas included developing a system of one-way frontage streets paralleling the Interstate improvements, and redesigning many streets and intersections adjacent to the study area. Critical to the overall design of the roadway was the elimination of the many close ingress and egress ramps from each of the four interchanges in the study area. Achieving this would allow for greater traffic movement, reduced accidents, and increased

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[346] Ibid., p. 5.

safety. Through the use of directional and diamond-style interchanges, the roadway would also offer increased traffic flow, reduced accidents, and better safety for motorists.

In 1970, the Knoxville-Knox County Metropolitan Planning Commission completed an updated land use and transportation plan for Knoxville and Knox County. Following many of the recommendations from previous general plans and transportation studies, MPC made the following proposals for improving Knoxville's street and highway system. Each of these major proposals were to be completed within a twenty-year timeframe.

> Interstate 40 should be widened to six lanes between Alcoa Highway and the I-40-I-75 interchange.
>
> Interstate 640 should be constructed forming the northern portion of the Inner Loop.
>
> The Downtown Loop should be constructed to improve access into and around the Central Business District.
>
> A four-lane expressway between the Walker Springs-I-40 interchange and the Callahan-I-75 interchange should be constucted to improve access to the north and west and to remove some of the local traffic from the interstates.
>
> The proposed Cherry Street Connector should be constructed to improve north-south traffic movement across Fort Loudoun Lake.
>
> The proposed Western Expressway should be constructed to take the place of Western Avenue and to improve traffic movement through this area.
>
> The proposed Oak Ridge Connector should be constructed from Solway to I-40, thus improving the transportation system between Knoxville and Oak Ridge.
>
> The Governor John Sevier Highway should be widened to four lanes and extended west across Fort Loudoun Lake to connect with I-40 at the Walker Springs interchange.
>
> The proposed South Knoxville Boulevard should be constructed to improve north-south traffic movement and to alleviate traffic congested on Chapman Highway.[347]

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[347] Knoxville-Knox County Metropolitan Planning Commission, Land Use and Transportation Plan (Knoxville, Tennessee: Knoxville-Knox County Metropolitan Planning Commission, February 26, 1970), pp. 55-56.

Many additional projects were identified that called for the widening, realignment or extension of streets and intersections throughout the county. All of the proposed projects were broken up into sectors to assist in the regional development of each area.

Knoxville's desire to expand the city limits occurred six different times between 1968 and 1972. The annexations were primarily built subdivisions or commercial property desiring municipal services. With the street systems already in place, the annexations did not affect the overall design of these facilities, however, future improvements and/or widenings would come under the supervision of the Knoxville Traffic Engineering Department.

In April, 1972, Wilbur Smith and Associates was asked to develop a plan of improvements for streets and intersections in Knoxville and portions of Knox County. This plan of improvements for the area was called TOPICS (Traffic Operations Program to Increase Capacity and Safety). The primary purpose of the program was to attempt to overcome the traffic bottlenecks and hazards requiring immediate attention without the cost and time factors involved in major construction. Sixty-one different intersections, primarily along arterials, were identified as needing improvements. Most of these improvements became necessary because the original planning and design of these facilities was deficient for high volumes of automobile traffic.

> The Knoxville street network has a highly irregular configuration reflecting the rolling topography of the area, the City itself being situated of a series of hills and ridges above the Lake Loudoun section of the Tennessee River. . . . These

> limitations have created an arterial system of high-volume radial routes feeding outward from the central area and low-volume disjointed circumferential routes. Many of the major arterials were constructed on previously aligned horizontal curves and steep grades of these facilities were not sufficiently improved, and today impede the safe and efficient flow of traffic.[348]

The plan provided recommendations for the improvement of traffic signal phasing at intersections, the physical improvement of intersections and portions of the Interstate (i.e., alignment and geometrics), and adjustments in signage, pavement markings, and railroad crossing barriers to improve overall traffic flow and safety. The total cost for all of the projects listed was a mere $5,260,000,[349] all of them affecting the Federal-Aid Primary and Secondary streets and roads in the city of Knoxville and portions of Knox County. Some of the proposed improvements were later completed but many still remain to be implemented.

Beginning in 1971, a number of regional street and highway plans were developed for Knoxville, Knox County and the sixteen county area defined by the East Tennessee Development District (ETDD). These road plans were designed to coordinate local and state transportation projects for the entire study area. Its primary emphasis was directed toward the Knoxville metropolitan area. Each of the plans presented a set of general goals, objectives and design principles. Some of the design principles included:

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[348]Wilbur Smith and Associates, Traffic Operations Program to Improve Capacity and Safety (Columbia, South Carolina: Wilbur Smith and Associates, April 1972), p. 5.

[349]Ibid., p. 187.

> Arteries should be limited in access as possible; as few as possible minor streets should intersect with arteries; where intersections occur they should be widely spaced and should provide adequate sight distances on both roads; minor streets should T-intersect if possible; and collector street intersections with arteries should be designed and/or spaced so as to minimize need for signalization or to permit progressive signal systems. . . .
>
> Arteries should be located so as to border, not bisect, areas of closely related land uses. . . .
>
> . . . . . .
>
> Minor streets should be designed to be short and circuitous to prevent volume buildings; where necessary to reduce volume and discourage through movement, discontinuites should be deliberately created. . . .[350]

The ETDD plans also contained definitions of the types of streets within the study area. These included: 1) Principal Arterials, 2) Minor Arterials, 3) Collector Streets, and 4) Local Streets.[351] These definitions followed the United States Department of Transportation's program of classifying all public streets and roads in the nation, and further emphasized the need for a definite hierarchy of streets in the Knoxville area. The studies also provided an analysis of the district's major road deficiencies, usually citing narrow widths and poor or bad alignments as the major causes of problems.[352] Many of the projects and costs identified in the ETDD road plans were also identified by Wilbur Smith and Associates in their TOPICS analysis for the Knoxville area.

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[350]East Tennessee Development District, Knoxville Metropolitan Area Major Road Plan (Knoxville, Tennessee: East Tennessee Development District, June 1972), pp. 4-5.

[351]Ibid., p. 10.

[352]Ibid., pp. 18-19.

In the early 1970's, Knoxvillians focused their attention on the completion of the Interstate highway serving the area.

> For East Tennessee, planning new roads and completing them appeared to be two different things and the area in the late 1960's and early 1970's became an exasperating and dangerous one of "missing links" in the overall system. Until late 1974 the interstate traveler or freight hauler was forced onto inadequate two-lane highways if bound for Chattanooga, Bristol, or Asheville. Completion of links to Cincinnati (I-75) and Nashville (I-40) also were late in coming. With the superhighways completed on either end of the "missing" segments, the older connecting roads were subjected to unparalleled amounts of traffic and mile-long lines of cars and trucks snaking along the roads were not uncommon, especially on Sundays and during holiday periods. Highway 11-W earned the nickname Bloody 11-W after a series of wrecks, and the American Automobile Association at one time recommended that its members avoid the Knoxville area because of the missing links.
>
> Finally, in December 1974 two of the four lanes of the incomplete interstates were opened, with all lanes to be completed by late 1975 or early 1976. The event, however, would alleviate but not solve Knoxville's interstate problems, foremost of which was an inadequate, outdated downtown four-lane segment, often referred to as a parking lot when congestion brought traffic to a standstill. But after World War II, the Magnolia expressway was advanced for its time but by 1975 it needed six or more lanes to handle the increased traffic load. I-640, a by-pass running north of the city, should syphon off some of this traffic but it would not be completed until the late 1970's or early 1980's.[353]

In 1974, Dr. John W. Pickering, of the Institute of Governmental Studies and Research at Memphis State University conducted a study of street and highway needs in Tennessee's ten largest cities. In his analysis of Knoxville's street and highway system, Dr. Pickering concluded that:

> In general, the street and highway problems of Knoxville seem to be the most massive of any city visited. The City has been playing "catchup" with its problems for at least two decades. This has resulted in an antiquated bridge system, inadequate arterials and connectors, and a poorly designed local street

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[353]Lucile Deadrick, op. cit., pp. 189-190.

> system particularly in the downtown area. These physical problems, when combined with previous political leadership that took little initiative but merely reacted to State proposals, has left the present group of planners, engineers, and administrators with a "nightmarish" set of problems. The current administration initiated a number of location and preliminary design studies during 1973 and 1974. The results of these studies, if implemented, could produce a substantial improvement in the level of service provided by the major street system. However, funding sources for the projects are not readily available. Given the declining level of local financial effort and the lack of federal receipts for this purpose, the previously described physical conditions can only intensify.
>
> The City is moving very slowly in addressing its needs. Although the Memorial Drive project will nearly complete a sound arterial system, maintenance and traffic problems appear to be mounting with only a minimal response by the City.[354]

In response to Knoxville's lack of adequate arterials and connector roads to feed into the Interstate highways and the Central Business District, a number of studies an proposals were developed to address these problems. Several different traffic engineering and planning firms developed studies looking at the Cherry Street Connector, the Ball Camp Pike Connector, the Weisgarber-Merchant Connector, and the Walker Springs Connector. Many of these projects are still pending because of local public opposition to their completion. Local officials feel that these facilities will give substantial relief to the congested Interstates while citizen groups fear displacement, disruption of their neighborhoods, and severe environmental impacts. The debate continues on.

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[354]John W. Pickering and Dwight T. Moore, An Assessment of Street and Highway Needs: A Study of the Ten Largest Cities in Tennessee (Memphis, Tennessee: The Institute of Governmental Studies and Research, Memphis State University, November 1974), pp. 50, 52.

> Knoxville's remaining highway deficiencies centered on its suburban access roads. These roads, some built decades earlier, have been unable to handle smoothly the increased traffic load generated by the extensive development of housing subdivision, apartment complexes, and shopping centers.[355]

In the mid-1970's, Knoxville's thirst for highway construction continued. Despite the completion of Interstate routes 40 and 75 through Knoxville and Knox County, other high-speed facilities were just being finished or were under construction. These facilities included the reconstruction and realignment of Rutledge Pike, the extension of the Pellissippi Parkway, and the completion of the Governor John Sevier Highway. These highways, located in the rural portions of the country, provided quick, direct access to the Interstates and other important highways but did not disrupt surrounding street patterns or systems. Street systems for new subdivisions adjacent to these highways were usually well designed, tying into these facilities via grade separated overpasses or expansive signalized intersections.

Throughout the 1970's and the early 1980's, Knoxvillians witnessed the birth of two new factors affecting the proper design and layout of streets and highways in Knoxville and Knox County. These factors were the emergence of the environmental impact statement (EIS), and the increasingly powerful voice of the public. Through the adoption of The National Environmental Policy Act (NEPA) of 1969 and the Environmental Quality Act of 1970, street and highway planners

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[355]Lucile Deadrick, op. cit., p. 190.

were now required to: state the environmental impacts of the project, list any adverse environmental effects which could not be avoided should the project be implemented, list alternatives, discuss the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and state any irreversible and irretrievable commitments of resources which would be involved if the project were implemented. Included within the legislation was the provision of required public hearings to discuss the project and gather citizen feelings. Disgruntlement over the design of many of the nation's Interstate highways (particularly in urban areas) awakened the Knox County citizenry to the possibilities of voicing their objections of such projects. While Knoxvillians have alwys been concerned over the design and layout of streets and highways, it was usually viewed as an engineering decision. Although "planning" was involved in the design and layout of streets and highways, it was not always viewed as the means to achieve the desired ends. With the help of the EIS and public participation, street and highway planning and design was no longer just an engineering decision.

Because of the new emphasis on "planning" in the design and layout of streets and highways in Knoxville and Knox County, other factors were examined more closely in determining the alignment of these facilities. Among the specific factors that were usually studied: the existing transportation network, existing land use, development trends, topography, existing and future traffic, design criteria, and environmental considerations. For the first time local

residents could have some confidence in the proper design and layout of new street and highway facilities or the reconstruction/redesign of streets and intersections.

In 1977, two important documents were released which would have a significant impact on the planning and design of Knoxville and Knox County's street and highway system in the future. These important documents were the 1995 Highway System Plan and the Final Environmental Impact Statement for the Knoxville Energy Exposition.

The ten-volume 1995 Highway System Plan was produced to recommend major construction of new street and highway facilities and improvements to existing facilities over a twenty year period. The plan, divided into a series of technical memorandums, provided an exhaustive analysis on the conditions and needs of the total system. Given that the basic overall pattern of the street system was radial in form, it was predicted that this system would not be able to move traffic in 1995 unless significant changes were made. The study called for the total reconstruction of the older sections of the Interstates plus the extension of the Pellissippi Parkway to Blount County as the major projects needed to move traffic effectively in 1995.[356] The study also called for extensive realignment work to be done on the city's major intersections and surrounding street patterns. Further refinement of the 1995 Highway System Plan began in 1976 with the initiation of the Transportation Improvement Program

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[356]Knoxville-Knox County Metropolitan Planning Commission, 1995 Highway System Plan--Summary (Knoxville, Tennessee: Knoxville-Knox County Metropolitan Planning Commission, 1977), p. 31.

(TIP) for the City of Knoxville and the urbanized area surrounding the city. The TIP provided a detailed program of street and highway projects that were to be completed over a five year period.

Knoxville's street and highway system developed into its present form because of the analysis provided in the Final Environmental Impact Statement, Knoxville International Energy Exposition. This study identified the many deficiencies of the Interstate highways leading into Knoxville (particularly Malfunction Junction) and the street system surrounding the site of the 1982 World's Fair. One of the main motivations for having the World's Fair in Knoxville was to achieve long term residual transportation improvements in the downtown area. The future vitality of downtown depended upon improved access, which was equated to improving Malfunction Junction. Thus, the objectives of Fair organizers and the City of Knoxville were to implement as many previously planned roadway improvements as possible to improve access and circulation within the downtown area and to improve access to the Fair site to promote residual development after the Fair was over. According to the EIS, these projects included: the complete reconstruction of the Interstate highways between Alcoa Highway (later extended to Papermill Drive) and Gay Street, the completion of the western leg of Interstate-640 (to divert through traffic on Interstate-75 away from the Fair site), the widening of Henley Street adjacent to the Fair site, the realignment of Main and Cumberland Avenues, and the closure of the Clinch Avenue viaduct and

South Broadway.[357] Each of these projects were completed prior to the start of the 1982 World's Fair. Many other minor street redesign and improvement projects were also proposed but most were never completed. The minor projects which were completed included: improving the geometrics of intersections along Kingston Pike and Cumberland Avenue, the development of Ailor and Dale Avenues into one-way pairs, and the improvement of Eleventh Street along the western border of the Fair site.

Critical to the implementation of these projects was the open communication between the parties involved in the planning, design and construction of the new facilities. During the initial planning stages, officials of the Fair and its transportation consultants, Barton-Aschman Associates, Inc., generated a transportation plan and a set of needs. These were reviewed with the City of Knoxville staff to achieve general concurrence. Cooperation among officials from the Fair, the City, and the Tennessee Department of Transportation (TDOT) was achieved in pursuing improvements requiring joint participation. The most important of these efforts was the advancement of the Interstate highway improvement program by about ten years. This was spearheaded by the World's Fair organizing committee and Chamber of Commerce with the strong support of the City. A bi-partisan political approach and extensive cooperation between private and public sector interests was key to the success of the Fair. During the last year

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[357] Haworth and Anderson, Inc., Final Environmental Impact Statement, Knoxville International Energy Exposition (Spokane, Washington: United States Department of Commerce, March 1977), pp. 197, 199.

prior to the opening of the Fair, additional transportation operating entities became involved. Communication and coordination were greatly enhanced by the establishment of a Traffic Planning Committee about fourteen months prior to the opening of the Fair. The committee met to discuss transportation planning and implementation progress and issues.

Samuel L. Parnell, Director of Knoxville's Traffic Engineering Department, reflected on the need to complete over $250,000,000 of street and highway improvement projects within a five year timeframe to ensure the success of the 1982 World's Fair.

> The 1982 World's Fair would not have occurred if the I-640 portion of th Knoxville Interstate System had not been completed and Malfunction Junction (the interchange of I-275 and I-40) reconstructed. The $30,000,000 loan to the World's Fair developer depended on monthly written assurances from the Governor of Tennessee to the banks involved that the interstate construction was on schedule. If construction had fallen behind schedule, the financial banking would have been withdrawn. . . . In order to expedite construction of I-640 and I-40 reconstruction TDOT carefully scheduled construction under as many as 28 different concurrent contracts.[358]

While Knoxville was gearing up for the 1982 World's Fair through massive Interstate reconstruction, the City's Traffic Engineering Department was also beginning a city-wide program of improving the alignment and configuration of critical intersections. Following many of the recommendations from the 1972 TOPICS study and the 1995 Highway System Plan, the City of Knoxville decided to

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[358]Samuel L. Parnell, The Knoxville World's Fair in Retrospect (Knoxville, Tennessee: Knoxville-Knox County Metropolitan Planning Commission, 1983), pp. 7-8.

emphasize the reconstruction of existing intersections and roadways instead of constructing new facilities. In examining the Transportation Improvement Programs for the Knoxville Urbanized Area from 1976 through 1983, fifty different intersection projects were identified as needing completion. To date thirty different intersections have been improved through alignment and channelization changes, costing several millions of dollars. The most visible projects in Knoxville have been along the major arterials such as Kingston Pike, Broadway and Chapman Highway. The intersections which have undergone the most radical changes include: Chapman Highway at Woodlawn Pike, Kingston Pike at Papermill Drive, Kingston Pike at Alcoa Highway, Kingston Pike at Newcomb Avenue, Western Avenue at University Avenue, and Broadway at Western Avenue. Poorly designed intersections which will need attention in the future include the troublesome Kingston Pike at Lyons View Pike, Schofield Street at Keith Avenue and Western Avenue, and McCalla Avenue at Vine Avenue and Olive Street. Most of the intersections that have undergone or will need reconstruction work were in areas where previously annexed communities joined together and were not planned as a whole street system.

During the late 1970's and early 1980's, Knoxville's street and highway system continued to grow despite all of the reconstruction work occurring at the time. Most of this growth occurred in new residential subdivisions in the western half of the county. A few new small annexations accommodated some of this growth but for the most part new growth occurred outside of Knoxville's city limits. According to the 1980 United States Bureau of the Census, Knox

County's total population grew 15.7 percent to 319,694, however, the county's portion of population growth amounted to a dramatic 42.4 percent increase.[359] The City of Knoxville's population growth amounted to a paltry 0.3 percent increase from 1970 to 1980.[360] All of these new residential subdivisions were required to be designed according to the standards set in the Subdivision Regulations and Standards for Knoxville and Knox County. One of the most important elements of these subdivision regulations was the design and layout of the street patterns. The design of the streets were required to be in conformance of the 1975 Highway System Plan, and Transportation Improvement Program for Knoxville and Knox County.

> The proposed road system of a subdivision shall generally provide for the continuance of existing or dedicated streets in adjoining or nearby tract. In addition, dedication of rights-of-way shall be provided to the satisfaction of the Planning Commission for the connection of the subdivision to any adjoining unsubdivided land, to accommodate an increase in traffic resulting form the subdivision, to provide for harmonious development of the subdivision in relation to the neighborhood in which it lies, and for the general safety and welfare of those benefitting from the subdivision.[361]

The subdivision regulations also provided a functional classification of streets and roads to establish a formal hierarchy of

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[359] Knoxville-Knox County Metropolitan Planning Commission, 1980 Census of Population and Housing (Knoxville, Tennessee: Knoxville-Knox County Metropolitan Planning Commission, August 1982), p. 5.

[360] Ibid.

[361] Knoxville-Knox County Metropolitan Planning Commission, Subdivision Regulations and Standards (Knoxville, Tennessee: Knoxville-Knox County Metropolitan Planning Commission, 1981), p. 6-1.

street facilities. This classification expanded previous hierarchies by defining six different types of streets: 1) Expressways, 2) Arterial Streets, 3) Collector Steets, 4) Minor Collector Streets, 5) Local Streets, including marginal access streets, loop streets, cul-de-sac streets and dead-end streets, and 6) Alleys. Minimum rights-of-way and maximum grades for all subdivision streets were also defined. Important to the design of all subdivision streets was the horizontal and vertical curves, and tangents of streets. These standards helped control vehicular speed according to the classification of streets.

The subdivision regulations for Knoxville and Knox County also made specific requirements regarding the pattern of streets in the subdivision. In reference to the angle of intersections "Roads within a subdivision shall be so laid out that intersections shall be as nearly as possible at right angles, and in no case shall the intersection of roads yield angles less than sixty degrees."[362] The subdivision regulations also required that the street pattern for a residential subdivision contain no street jogs or slightly offset intersections "Street jogs with centerline offsets of less than 125 feet shall not be allowed."[363]

In 1981, the Knoxville-Knox County Metropolitan Planning Commission continued its involvement of improving the area's poorly designed street and highway system by producing a set of documents

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[362] Ibid., p. 6-5.

[363] Ibid., p. 6-8.

providing detailed information on the proper design and layout of collector street facilities. These documents were produced to guide developers in generating a plan for traffic circulation in order to avoid the piecemeal approach to designing streets and street systems. In developing residential subdivisions, many streets designed as local streets became collector-type facilities or were used as shortcuts through neighborhoods because of substandard arterial streets adjacent to the subdivision. These problems are further amplified below:

> The configuration of a residential street system is important from two general standpoints: 1) collector streets serve as a primary means to access between local and major streets; and 2) local configurations should not serve as convenient bypasses around congested or substandards arterial streets. If a collector street is continuous between two substandard arterial streets, motorists will tend to use that street as a shortcut through the residential area. This would be a particularly serious problem in Knoxville and Knox County because so many of the streets designated are arterials are old country roads that have not been improved. To avoid short cutting through residential areas, the configuration of a collector street needs to be discontinuous. A discontinuous collector street configuration can still serve traffic between the interior of the residential area and the arterial. A "watershed" effect will result, where traffic is encouraged to flow toward the external boundaries of the residential area via the collector street.[364]

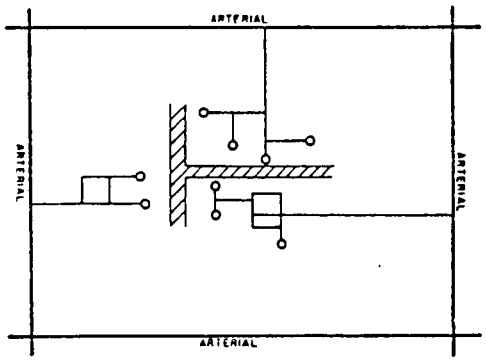
The study also provided a set of street design guidelines for the alignment and layout of collector streets within residential subdivisions. These guidelines are summarized and shown in Figure 68. Included in this total analysis was a step-by-step method for planning

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[364]Knoxville-Knox County Metropolitan Planning Commission, A Consolidated Manual for Collector Street Implementation (Knoxville, Tennessee: Knoxville-Knox County Metropolitan Planning Commission, December 1981), no page number.

GUIDELINE 1

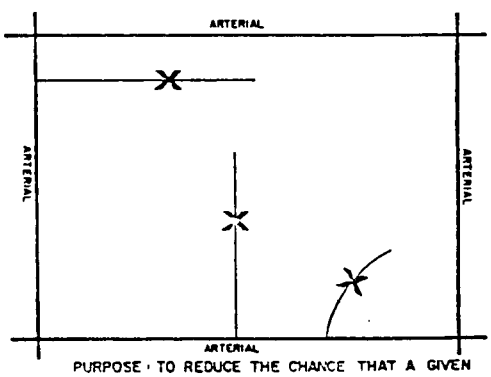
ESTABLISH AN "IMAGINARY BARRIER" WITHIN THE INTERIOR OF AN AREA, AND DO NOT ALLOW STREETS TO CROSS THIS "BARRIER"



PURPOSE: MOTORISTS ARE MORE LIKELY TO SHORTCUT BY TRAVELING THROUGH THE INTERIOR OF AN AREA THAN AROUND ITS PERIMETER.

GUIDELINE 2

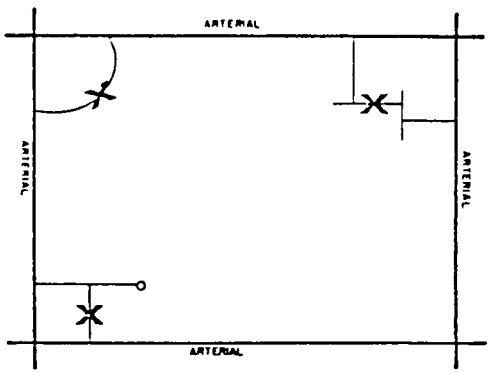
PROHIBIT OR DISCOURAGE ANY STREET FROM PASSING THROUGH MORE THAN THREE-TENTHS OF AN AREA



PURPOSE: TO REDUCE THE CHANCE THAT A GIVEN STREET WOULD BECOME PART OF A FUTURE SHORTCUT PATH

GUIDELINE 3

PROHIBIT OR DISCOURAGE ANY STREET FROM MAKING A DIRECT OR INDIRECT CONNECTION BETWEEN TWO ARTERIAL STREETS



GUIDELINE 4

"STUB STREETS" SHOULD BE ESTABLISHED AROUND THE PERIMETER OF AN AREA, BUT NOT IN THE INTERIOR OF A RESIDENTIAL AREA.

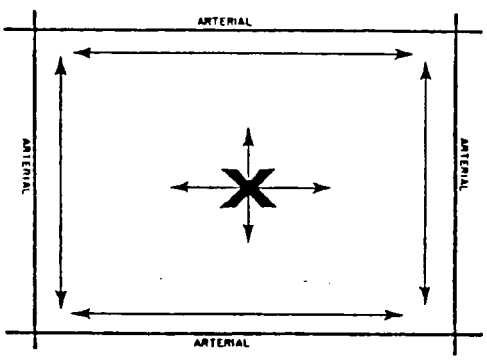


Figure 68. Collector Street Guidelines.

Source: Knoxville-Knox County Metropolitan Planning Commission, A Consolidated Manual for Collector Street Implementation (Knoxville, Tennessee: Knoxville-Knox County Metropolitan Planning Commission, December 1981), no page number.

the configuration of collector streets within a residential area. It also recommended making an adjustment in the previously described subdivision regulations and standards by advising that the minimum offset of all intersections on collector streets and arterials be at least 400 feet, a 275 foot increase over the previous standard. This recommendation has, as of yet, not been incorporated into the existing subdivision regulations for Knoxville and Knox County.

During 1982 and 1983, Knoxvillians continued to develop plans for future rehabilitation and expansion of its street and highway system. With the close of the 1982 World's Fair in October, 1982, local officials and citizens began to once again deal with the issues of future access into development occurring in the Lower Second Creek valley replacing the World's Fair, the extension of the Pellissippi Parkway from Interstate 40/75 to Blount County, the alignment and effects of the South Knoxville Boulevard and Bridge, and Phases II and III of Interstate highway improvements.

In terms of function, the most critical improvements for Knoxville and Knox County's street and highway system will be the rehabilitation of its Interstate highways, particularly along Interstate 40/75, from Papermill Drive to Loudoun County line. Many of the Interstate 40/75 interchanges in west Knoxville and west Knox County were designed and built in the late 1960's as rural diamond interchanges. This design was appropriate when the major land uses generated low traffic volumes. Today, the area is in high demand and the improved accessibility provided by the transportation network has generated large traffic volumes. As development occurred,

transportation demands increased so that more improvements became necessary. These additional improvements were very expensive due to the adverse terrain and the lack of existing streets to connect the developing land to Interstate 40/75.

In addition to mainline improvements, there is a need to improve the interchanging local streets. The local streets which interchange with Interstate 40/75 were originally farm-to-market roads which served underdeveloped parts of Knox County until the freeway was constructed. Many of these country roads have developed into "nightmarish" vehicular facilities with inadequate capacity, poor alignment, and little cohesion to surrounding development and streets. Proposals have been made to develop new north-south street across the Interstate in order to alleviate "through-movement" congestion at existing interchanges plus develop a continuous system of frontage roads to assist in east-west traffic movements. Many different alignments have been generated for these new facilities, however, final plans have not been developed for the entire corridor.

In order to fully understand the historical evolution of Knoxville's street and highway system, a case study was developed to examine the layout of the street system in a specific area of Knoxville. This information presented in Chapter IV, will focus on the historical development of the streets within the study area, and examine the physical deficiencies of the existing system.

CHAPTER IV

CASE STUDY INVESTIGATION

Knoxville's street and highway system has undergone tremendous changes over the last two hundred years. In Chapter III, The History of Knoxville's Street and Highway System, a comprehensive examination of the evolution of Knoxville's street and highway system was made. In that chapter, only the major factors and influences on the total street and highway network were defined. Specific impacts on the design and layout of streets and street patterns were not made due to the lack of complete information and the impossible logistical problems involved. In order to examine Knoxville's street and highway system in greater detail, a case study was developed to look at a specific section of the total existing street network.

The case study area chosen for further analysis is shown on Figure 69. The case study area is bounded by Alcoa Highway to the west; Cumberland and Main Avenues to the south; the Downtown Business Loop and a Southern Railway line to the east; and, a line linking Wilkins Street, Pickett Avenue, Hinton Avenue, Cullen Street, and Caswell Street to the north. Included within the boundary are portions of five distinct neighborhoods: 1) Fort Sanders, 2) Mechanicsville, 3) North Central Knoxville, 4) Fourth and Gill, and 5) the Central Business District. This case study area was chosen because it represented a cross-section of the total history of Knoxville's street and highway system. The case study area was also

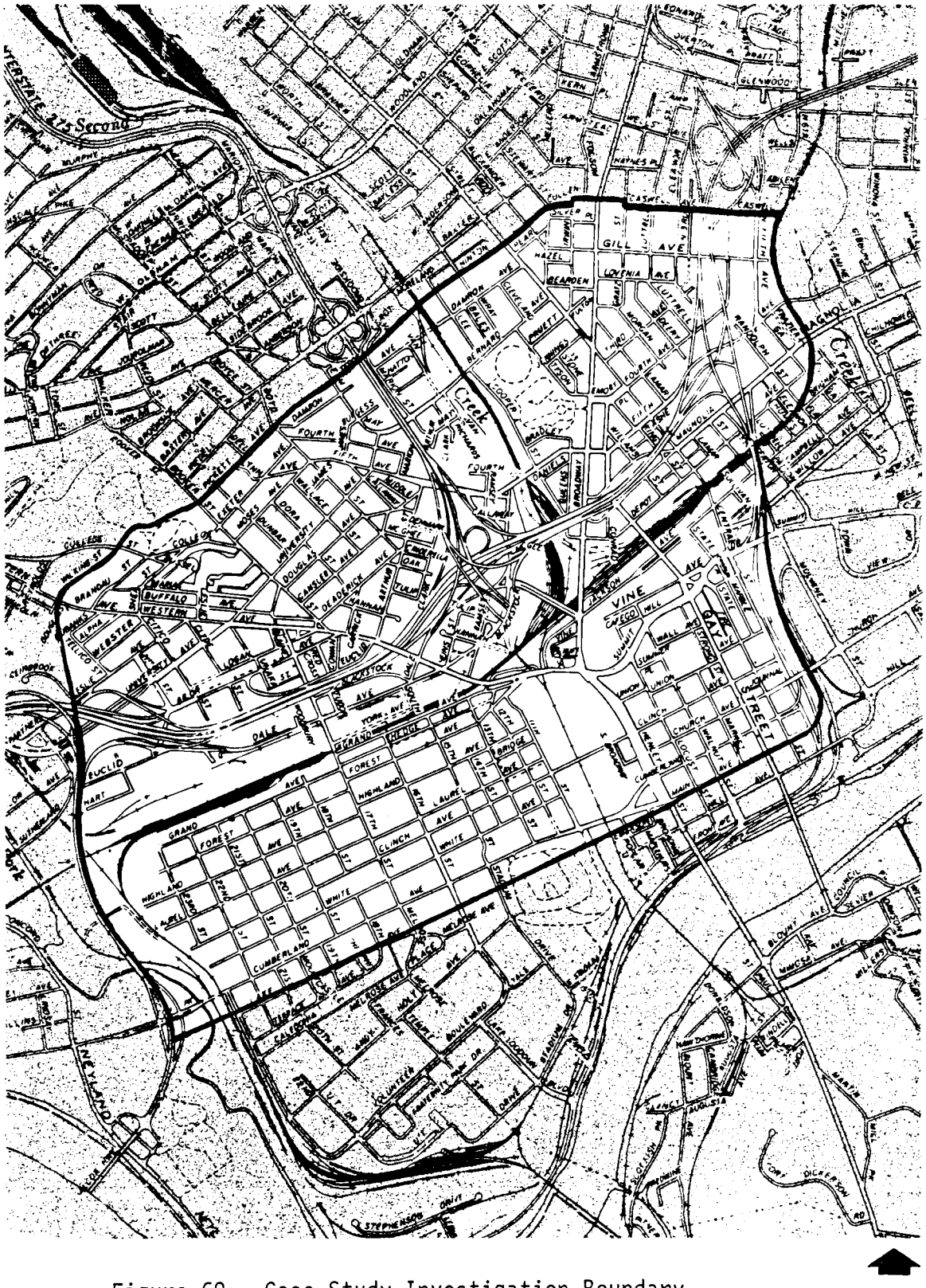


Figure 69. Case Study Investigation Boundary.

Source: Knoxville-Knox County Metropolitan Planning Commission.

chosen because it features a wide variety of streets and street patterns, street design problems, highway facilities, land uses, and neighborhoods.

In order to provide a basis for examining the physical layout of the street and highway system within the case study boundary, a brief review of the history of street and highway development was needed. This historical overview covered all of the periods described in Chapter III, from the founding of the town in 1791 to October, 1983. Following the historical review of the case study area's street and highway system, a detailed analysis of the current design deficiencies was performed. Using modern design standards for street and highway layout, the problems of an evolving street network were brought forth.

A. HISTORICAL REVIEW

The street and highway system within the case study boundary reflects the complete evolution of Knoxville's street and highway network. Beginning in 1791, a sixteen square block gridiron street pattern was platted in the current Central Business District during the founding and early settlement of Knoxville. Knoxville's early growth prompted city forefathers to annex additional land into the town in 1795. New streets were added to the gridiron street pattern to the north and west (see Figure 70).

In 1831, the City of Knoxville decided to annex additional land to the north and west. Despite a sloping topography toward Second Creek, new gridiron streets were added to the street network. With

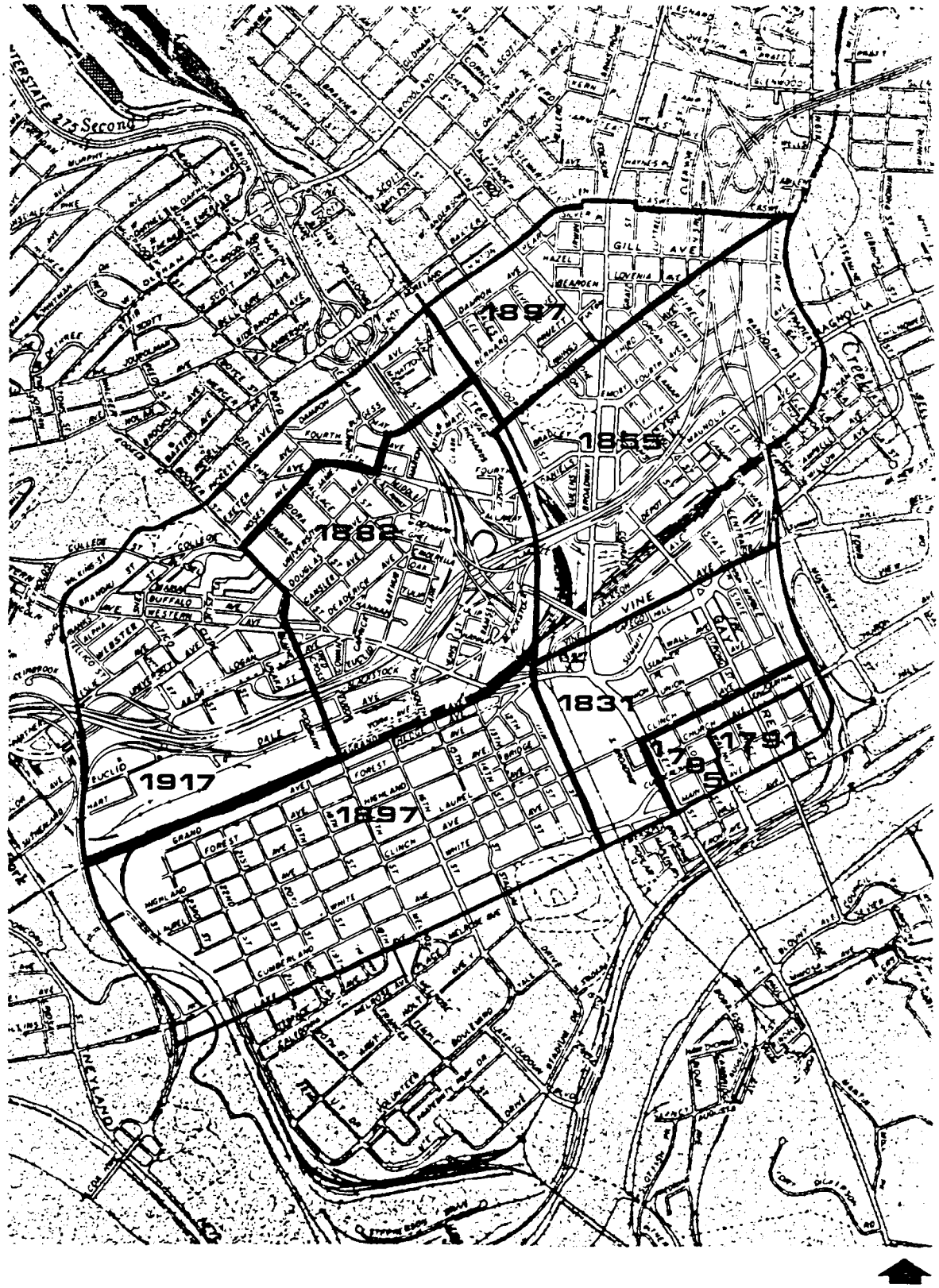


Figure 70. Growth of the Street System.

Source: Knoxville-Knox County Metropolitan Planning Commission.

property owners desiring improvements be made to the total street network, Main Avenue and Gay Street developed into the primary thoroughfares east-west and north-south.

Although Knoxville had plenty of vacant land to develop within the corporate boundaries of the city, talk of a railroad line finally connecting Knoxville with the rest of the world prompted the construction of many residential, commercial and industrial buildings along First and Second Creeks and the level areas north of town. In 1855, with the placement of Knoxville's first railroad line in the Second Creek valley and the flat lands north of the city, Knoxville pushed the city limits north beyond the East Tennessee and Virginia Railroad depot to encompass portions of the current Fourth and Gill, and North Central Knoxville neighborhoods. Shortly before the Civil War, new railroad lines connected with Knoxville. These railroad lines influenced the street patterns around them because much of the land around the railroad stations was developed by the railroads. Also, the railroad companies limited the number of street crossings, further emphasizing existing main streets in the area.

In the years after the Civil War, Knoxville began to grow in leaps and bounds, both economically and physically. New residential communities developed around the city. In 1868, the town of East Knoxville, was annexed into the city of Knoxville. The town's gridiron street pattern blended well with Knoxville's gridiron despite some difficulties with First Creek and the steep topography of the area.

In 1882, another suburban community was annexed into the city

of Knoxville. The city of Mechanicsville's street system was a difficult mix of gridiron and organic streets centered around Asylum Avenue (Western Avenue). The city's street system was not coordinated with Knoxville's gridiron and radial streets, and as a result, many poorly designed intersections and building lots developed. The existence of railroad lines to the south and east prevented any hope of coordination.

Knoxville was introduced to the electric street railway in 1890. This technological breakthrough in transportation assisted in the growth of two other gridiron suburbs. The cities of North Knoxville and West Knoxville developed separate gridiron street systems in piecemeal fashion, isolated by the expansive railroad rights-of-way. In 1897, the City of Knoxville annexed these communities, effectivey doubling the size of Knoxville. A year later, in 1898, the Gay Street bridge was finished, permanently linking Knoxville to residential development in South Knoxville.

Around the turn-of-the-century, Knoxville began making other capital improvements to the street system by building a series of bridges and viaducts over the railroads, creeks and other physical obstacles. These new facilities provided direct linkage between the Central Business District and surrounding residential communities.

At the same time, Knoxvillians began to discover the pleasure and convenience of the automobile. However, the full effects of the automobile on Knoxville's street system were not felt until the 1920's when congestion became a common occurrence. Knoxville's street system continued to grow outside the city limits. In 1917, the City of

Knoxville decided to annex additional territory once again. Knoxville accepted a total of twenty-two additional square miles, comprised mostly of communities with ad-hoc, unplanned street systems.

In 1927, the City of Knoxville hired Harland Bartholomew and Associates to prepare the city's fist Major Thoroughfare Plan. This study provided an in-depth analysis of the conditions and problems with the overall street system. The study also made specific recommendations for the improvement of the total street system. The most important recommendations made in the study which were implemented were the widening and extension of Henley Street, the construction of the Henley Street bridge, and the widening and extension of Wall Avenue to Vine Avenue. The study also brought forward a set of street design standards and principles to guide local officials in designing streets in the future.

During the Depression, Knoxville's street system did not appreciably increase in size and quality. Not until 1941 did Knoxville attempt to make any adjustments in the street system. Harland Bartholomew and Associates recommended that a riverfront highway be constructed adjacent to the Central Business District, linking East Knoxville with the University of Tennessee. This was later built as Neyland Drive and the Downtown Business Loop. In 1945, the city of Knoxville began to develop an interest in high-speed arterials running north-south and east-west through the city, providing direct access to the Central Business District. These expressways were later built in the 1950's and became the predecessors to Interstate highways 40 and 75.

Traffic congestion in Knoxville became acute during the 1960's. Knoxville became known for its antiquated Interstate interchange called Malfunction Junction. Many proposals and studies called for its replacement and other improvements to the remaining street system. Knoxville's desire to expand the city limits occurred once again in 1962 to accommodate for all of the suburban growth.

Major improvements to Knoxville's street and highway system did not begin until 1979 with the coming of the 1982 World's Fair. Many streets and intersections around the Fair site and along arterials were reconstructed as well as Malfunction Junction and significant portions of the Interstate highways. In the 1980's, Knoxville continued to work on improving its street and highway system by planning new projects to increase the capacity and safety of the street and highway system.

B. EXAMINATION OF SPECIFIC STREET DESIGN PROBLEMS

The case study investigation area contains a wide variety of streets, street patterns, and, of course, street design problems. The diversity of street facilities reflects the study area's evolution from a frontier settlement to a bustling metropolitan area. During the course of this evolution, streets were developed often in an ad-hoc, piecemeal fashion. With the coming of the automobile, deficiencies in the design of the study area's street system were realized. Some improvements have been made, as previously discussed, however, the total area still contains many poorly designed streets and intersections. In this section, these deficiencies in design will be discussed.

In beginning the analysis of specific street design problems in the case study area, it was necessary to look at what types of streets are there. Below is a list of the hierarchy of steets which are contained in the case study area. Using the breakdown listed in the 1995 Highway System Plan for Knoxville and Knox County, four different categories were identified: 1) Expressways and Freeways, 2) Major and Minor Arterials, 3) Collector Streets, and 4) Local Streets. These streets are shown graphically on Figure 71.

Expressway and Freeways	Major and Minor Arterials	Collector Streets
Interstate-40	Henley Street	Gay Street
Insterstate-275	Broadway	16th Street
Alcoa Highway	Western Avenue	17th Street
Downtown Business Loop	Magnolia Avenue	22nd Street
	Cumberland Avenue	Booker Street
	Central Street	Fifth Avenue
	Summit Hill Drive	Clinch Avenue
		Vine Avenue
		University Avenue
		Main Street
		Volunteer Boulevard[365]
(◀)	(●)	(✸)

All of the remaining streets located in the case study boundary are defined as Local Streets.

The case study investigation area contains an ample proportion of each variety of street listed above, however, their function in aggregate is not well defined and often disjointed. For example, for years the City of Knoxville pondered with the problem of providing direct access from the University of Tennessee to Interstates 40 and

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[365]Knoxville-Knox County Metropolitan Planning Commission, 1995 Highway System Plan, Vol. 4, p. 12.

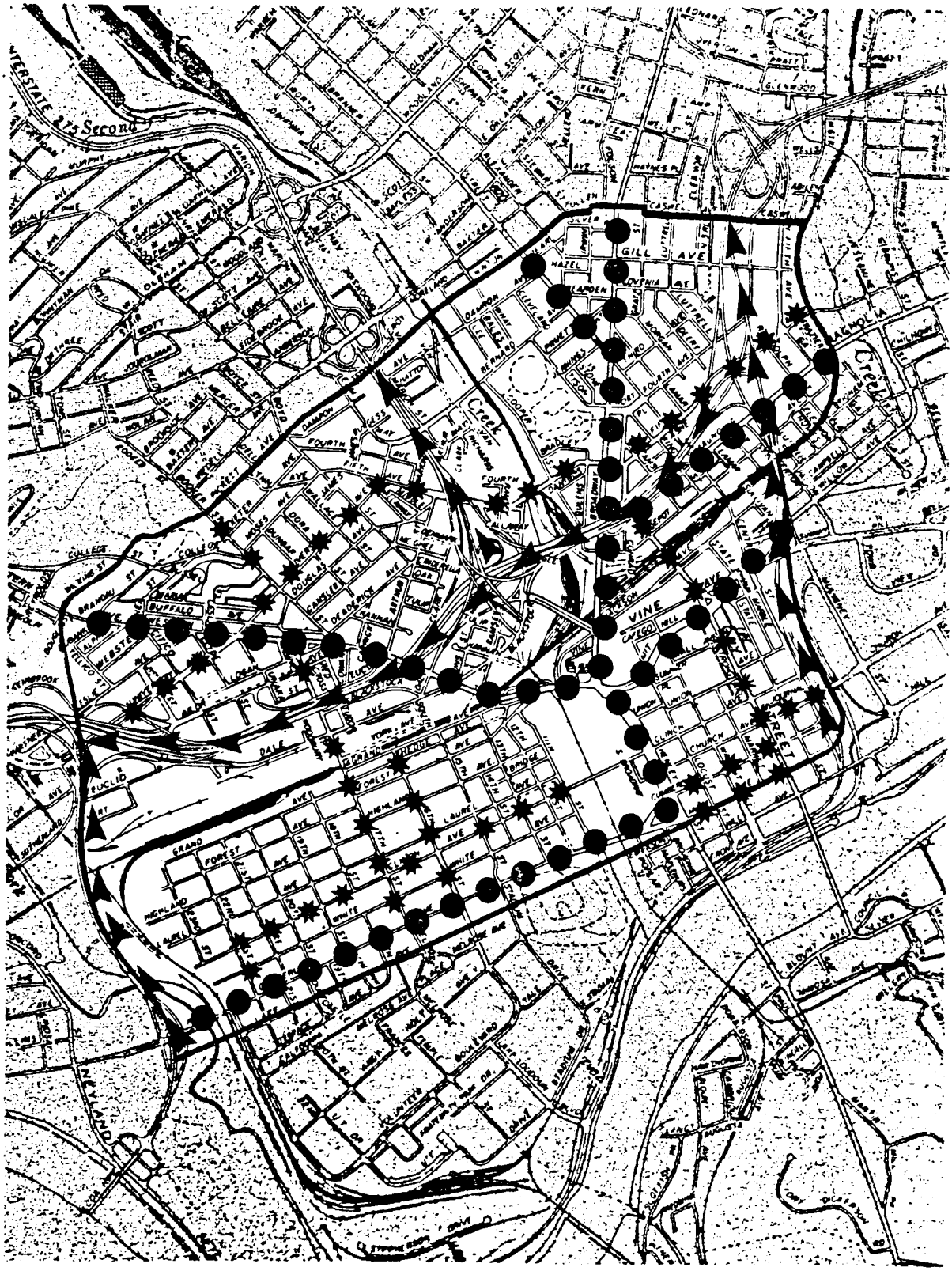


Figure 71. Hierarchy of Streets.

Source: Knoxville-Knox County Metropolitan Planning Commission.

275. Access was provided with a severe jog of Sixteenth and Seventeenth Streets tieing into Volunteer Boulevard. Since neither Sixteenth or Seventeenth Streets were arterials, these routes suffered in lack of capacity for the needs of the campus. Proposals by Barton-Aschman Associates, Inc. recommended connecting Sixteenth and Seventeenth Streets with Volunteer Boulevard. These plans were defeated by angry residents of Fort Sanders fearing further displacement and disruption in the neighborhood. Other connections between arterials and expressways as well as collector streets and arterials were also disjointed or poorly connected in terms of function.

> One design problem which is now being attacked in many cities with older grid system is how to create a positive identification of the hierarchy of streets, from arterial to collector to local. Often, right-of-way widths for the three categories are not very different nor are geometric design elements. Thus, in order to better allow the driver to identify which streets should be used as arterials and which as locals, designers are attempting to use cross-section design, landscaping, and location to create a higher order of differentiation among street types.[366]

Street jogs, dead-end streets and street closures were also common throughout the case study area. Figure 72 shows the location of each of these street design problems. Dead-end streets and street closures in the study area were caused primarily by the design and placement of Interstate highways 40 and 275, or the location of the Southern Railway, and Louisville and Nashville Railroad lines. These facilities, with their expansive rights-of-way, allowed only a few streets to cross over, forcing the closure and/or the termination of many streets. In several areas adjacent to the Interstates and

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[366] JHK and Associates, op. cit., p. 3-13.

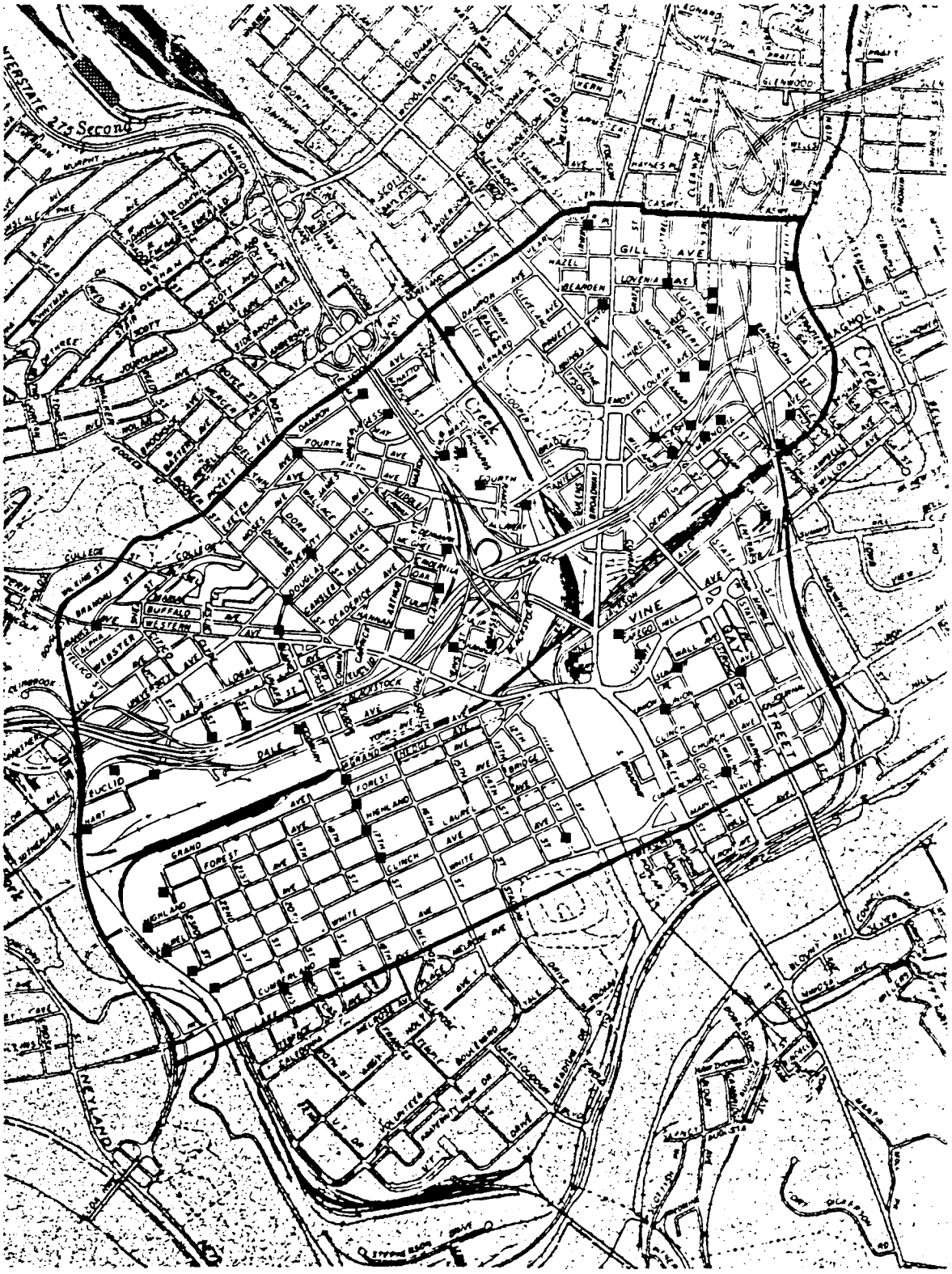


Figure 72. Street Jogs, Dead-End Streets and Street Closures.

Source: Knoxville-Knox County Metropolitan Planning Commission.

railroad lines are the names of streets which used to be "through" streets. Morgan Street, Lamar Street, Fourth Avenue, Tulip Street, Dameron Avenue, and Euclid Avenue are obvious examples. While these street terminations have hindered "direct" traffic movement, it has helped in defining what streets should have been and need to be "traffic movement" streets. Although traffic movement is more orderly in the study, certain inconveniences were generated. For example, Forest Avenue, a residential street in design is attempting to function as a collector street because of denied "through" access, and, also because of the use of modern traffic engineering devices and practices such as the placement of stop signs, pavement markings, surrounding street controls, etc. As a result, streets like Forest Avenue experience heavy congestion, difficult turning movements, restricted on-street parking, increased noise, and changes in street and neighborhood character.

> A key question which often arises for the street planner and street designer is whether it is better to "concentrate" traffic on fewer, but wider streets, or whether to "disperse" traffic onto a greater number of lesser streets. Traffic safety and operations are affected by the solution chosen, although no definitive work seems to show that one technique may be preferable.[367]

The location and placement of the Interstates and railroad lines have also helped to cause further separation and isolation between existing and future residential communities such as Fort Sanders and Mechanicsville. It should be noted that not all of the street closures and dead-end streets within the study area boundary

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[367] Ibid.

are detrimental to the overall street system. For example, it would have probably been cost prohibitive to have built viaducts over railroad tracks, a highway, and a large creek on the western half of Fort Sanders to connect all east-west streets with Concord Street. With the existence of Cumberland Avenue, most east-west movements could be accommodated.

The case study area also contained a significant number of jogged streets. Most of the notable street jogs in the study area are located in the Fort Sanders neighborhood. These street design deficiencies occurred in the gradual development of West Knoxville in the 1880's and 1890's when the city became an affluent suburb for Knoxville. Individual developers platted streets in a basic gridiron pattern in order to sell residential lots more quicky but did not concern themselves over the creation of street jogs. Since most of the movements of existing traffic were in an east-west direction for the hillside town, there were little turning conflicts or problems with offset streets. With the creation of the automobile, these street alignments caused numerous accidents and severe congestion until traffic signals and a logical system of one-way streets were installed throughout the community.

Using the present subdivision standards for intersection spacing of 125 feet[368] between center lines, each of the deficient intersections shown on Figure 72 did not meet this basic requirement.

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[368]Knoxville-Knox County Metropolitan Planning Commission, Subdivision Regulations and Standards, p. 6-8.

The case study area also contained a significant number of poorly designed intersections. Each of these deficient intersections suffered from an excessive number of legs (four or more) or a number of acute-angled streets entering the intersections. In many cases, both of the conditions occurred simultaneously. The minimum angle allowed by the Knoxville-Knox County Subdivision Regulations and Standards is sixty degrees[369] and this criteria was used to identify those intersections in Figure 73.

As one will notice, almost all of the deficient intersections are located in the Mechanicsville, North Central Knoxville, and Fourth and Gill neighborhoods. As mentioned in Chapter III, each of these neighborhoods were developed in a mixture of gridiron and organic street patterns, often in an ad-hoc, unplanned manner for use by horse and buggy. Residents and businesses in these areas have suffered because of these design deficiencies. Many people noted the difficulties of making normal turns from these intersections. Because of their fear of accidents, motorists in the area adjusted their travel patterns in order to take a longer but safer journey. Interstate and surface street reconstruction in the 1980's did not significantly alter the layout of these intersections, however, the application of one-way signs and traffic signals have minimized the dangers of some of these intersections. Still, a number of other poorly designed intersections remain. Some of these intersections also are deficient in their design because on-street parking blocking the views of motorists and/or the corner radii of the curbs themselves are too

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[369] Ibid., p. 6-5.

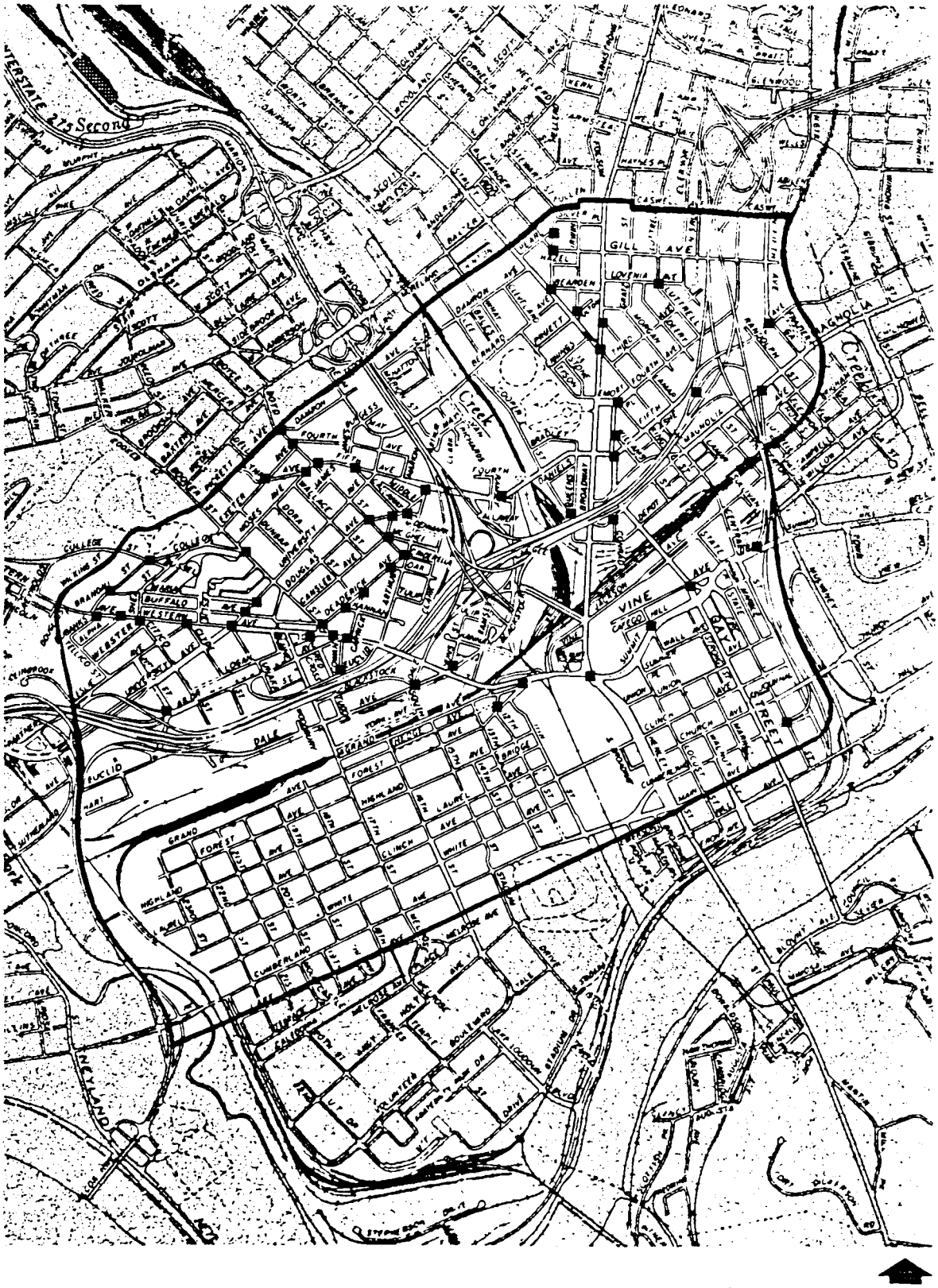


Figure 73. Acute-Angled and Multi-Leg Intersections.

Source: Knoxville-Knox County Metropolitan Planning Commission.

small to allow for comfortable turns by today's motor vehicles.

In reviewing the grades of streets within the case study area, many streets exceed the maximum angles permitted by the Subdivision Regulations and Standards for Knoxville and Knox County. These regulations allow expressways to be laid out at a 5 percent maximum grade; arterials at 6 percent; collector streets at 10 percent; and, local streets at 12 percent.[370] Those streets which exceed those maximum grades are shown on Figure 74. Most of these streets were designed and laid out during Knoxville's early days of development, unconscious to the difficulties of travel over these streets.

The design and location of the expressways within the case study boundary are now modern and contain few design deficiencies. Later phases of Interstate reconstruction will take care of some of the minor design problems which exist. For example, some minor weaving and sight problems still exist with the Downtown Business Loop's connection into Interstate-40 and Vine Avenue, but again, these design deficiencies will be mitigated during future reconstruction.

C. CONDUCTING INTERVIEWS

During the course of researching the history and design problems of the street and highway system in the case study investigation area, a number of formal and informal personal interviews were conducted. These interviews were intended to discover interesting facts about the history of the street and highway system in the case

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[370] Ibid., p. 6-4.

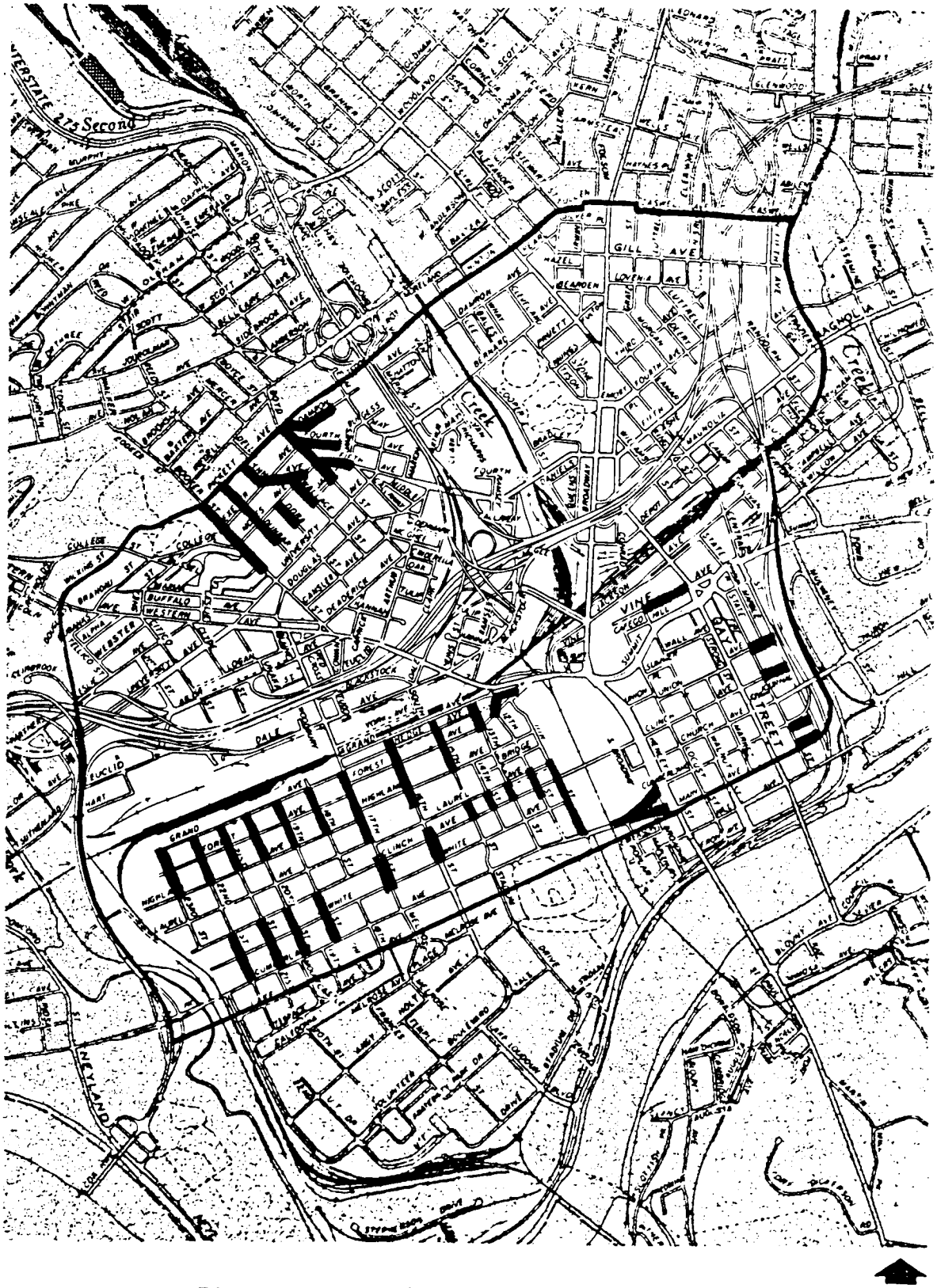


Figure 74. Street Grades in Excess of Maximum Standards.

Source: Knoxville-Knox County Metropolitan Planning Commission.

study investigation area, and reveal problems not apparent in the written and cartographical history analysis, as previously discussed. The interviews were divided into two main areas: 1) interviews with the individuals involved with the planning and design of the street and highway system in the case study investigation boundary, and 2) interviews with lay citizens and community leaders who drive daily on the street system in the case study investigation boundary.

Unfortunately, the data and opinions gathered with the interviews did not lead to a better understanding of the development and problems of the street and highway system in the case study investigation boundary. The information received merely supported the analysis of the written and cartographical histories of the case study area. One common theme did prevail during the interviews: no one had any real idea as to how or why the case study's street and highway system developed the way it did but agreed the area still has many street design problems.

In summary, this examination of the selected case study area has demonstrated the many different street design problems which currently still exist. These problems have developed over the course of two hundred years and are felt to be common throughout the rest of the city's street and highway system. Recent reconstruction and traffic engineering work has reduced the seriousness of these street design deficiencies but much is left to do. Overcoming the lack of good street design and planning will be necessary in later years as the street system will continue to evolve and change, and new transportation technologies are developed.

CHAPTER V

SUMMARY AND CONCLUSIONS

> It is fashionable nowadays to heap abuse upon the roads of the United States because of their relative inability to absorb the avalanche of motor vehicles descending upon them. That they are not capable of handling at all times the demands placed upon them cannot be denied; what is not always appreciated however is the roads of the United States were never purpose-built to meet modern . . . needs but that, instead, the motor vehicle was thrust upon a road system already in existence and possessed of a deep association with the history of the country. For this reason therefore, it is desirable to present a picture of how the existing roads evolved; by doing so it is possible to explain the existence of certain obstacles in the way of adapting the inhereted roads to meet modern requirements.[371]

Since the beginning of time, mankind has developed systems of streets and highways. These systems have ranged from narrow trails in the African wilderness to superhighways in the United States and Europe. All of these facilities have had one thing in common: man has thought about the design and layout of his streets and highways to one degree or another.

The art and science of street and highway design and layout has evolved for thousands of years. During the course of this evolution many mistakes were made, however, many successes were also achieved. The design and layout of cities and villages were the products of these past accomplishments and failures. The design and layout of

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[371] C.A. O'Flaherty, Highways Volume 1, Highway and Traffic (New York, New York: Butler and Tanner, Ltd., 1974), p. 1.

Knoxville's street and highway system is the physical result of this total evolution.

The direction of this thesis has been to determine what factors have influenced the design and layout of Knoxville's street and highway system. To accomplish this, it was necessary to chart the evolution of street and highway design around the world, the United States, and Tennessee. The organization and presentation of materials from these geographic regions lead to the discussion of the history of Knoxville's street and highway system.

A. SUMMARY

Before offering any conclusions about this study, a summary of the material already presented is in order. It is helpful to review all of the information before attempting to advance an opinion on the factors involved in the design and layout of Knoxville's street and highway system.

Street and highway design and layout around the world began with man's early travels following the paths of wild game. These nomadic journeys continued for thousands of years when the first villages were formed. These villages were usually organized in distinctive rows of huts thus forming the first streets.

The design and layout of streets and roads changed significantly with the invention of the wheel. Its impact has been everlasting as man discovered the logic of designing level, straight streets and roads. The gridiron street pattern satisfied this requirement and was used extensively in early city development. Many

cities also had one wide, main straight street in order to march troops in impressive and powerful formations.

As these initial cities developed over time, changes to the existing street patterns became necessary. Man's desire to redevelop decaying parts of town often changed the configuration of the total street system. Flooding and other natural disasters also played havoc on street patterns of cities.

Famous Grecian architect and city planner, Hippodamus, designed a number of cities with gridiron street patterns in a north-south, east-west direction to allow for more light to shine on boulevards traversing east-west. But, many of these gridiron street patterns were illogically built on steep topography causing many difficulties. The Romans also built gridiron military camps called castras because they were the easiest to assemble.

During the medieval days, cities were built with large walls and street patterns like mazes. These features were purposely designed in order to offer protection from enemy troops. The maze of streets also served the purpose of breaking the force of strong winds.

The coastal plains of Central and South America had roads that were designed to be staight and wide in order to be able to march gladiators in impressive and powerful formations. The cities in these areas usually had gridiron street systems in which sun orientation, religion and architecture were factors that influenced their configuration.

The design and layout of the wide primary straight street gained a rebirth in Europe after it was understood that the medieval

street plan could not adequately accommodate the increasing volumes of wheeled traffic.

The Renaissance of Europe provided some new ideas in street planning and design. Cities during the Renaissance refined the definition of street hierarchy by creating traffic spaces, residential spaces, and pedestrian spaces. Fortified cities produced a variety of street patterns including a radial-concentric circle design, gridiron, organic, and combinations of each of these patterns. Cities also incorporated sophisticated systems of canals in the total design of the street system.

During the nineteenth and twentieth centuries the world experienced the dawning and growth of the Industrial Revolution and the New Town Movement. New forms of street design and layout were generated during this period. Ebenezer Howard's concept of the Garden City included a street pattern shaped like the spokes of a wheel. For the first time a city would have a system of streets combining radial streets with ring roads on the exterior. Although the concept of Garden City was never built as was designed, it did provide the stimulus to use other Garden City concepts with a system of curvilinear streets in total street design.

With the invention of the automobile, new forms of street planning and design were born. The ideas of grade separation of traffic, developing linear cities with one central automobile spine, one-way streets, and parkways were the result of the automobile's impact on existing street systems.

Street and highway design and layout in the United States has

also had a long and varied history. In many ways, this history has paralleled the development of the street around the world, only in a shorter timeframe. Street and highway design and layout began with the early Indian and animal trails and progressed to the development of extensive networks of streets and superhighways across the land. In between, the United States experienced a number of changes.

Early Spanish settlements were developed under the "Laws of the Indies." These laws guided the development of these settlements by specifiying the types and locations of the streets that were to be laid out. The gridiron street pattern was indirectly prescribed to be used in these settlements. The laws also specified that streets be aligned with the four cardinal points on the compass in order to prevent exposure to the winds. The creation of the Laws of the Indies can be traced back to the days of the Roman Empire when it extended into Spain.

The gridiron street pattern also became popular in the colonization of America. Cities like Philadelphia, Pennsylvania, and Savannah, Georgia, developed beautiful gridiron street plans which were later copied by many other frontier towns. They also contained public open spaces in order to interrupt the monotony of the gridiron.

Many non-gridiron towns also developed in America's early days. Topography and other natural features influenced the design and layout of organic street patterns. Boston, Massachusetts, and New York City were notable examples. Annapolis, Maryland's, street pattern was designed in a distinctive combination of radial and ring streets. Washington, D.C. had a street pattern which combined the best features

of the gridiron streets. These street patterns were superimposed upon one another to link important buildings with wide avenues and vistas. Unfortunately, with each of these cities, the street pattern did not function well and created many unusual intersections and adjacent building lots.

City street design and layout during the expansion of America produced an interesting variety of street patterns. A number of distinctive gridiron street plans were created to attract new settlers to these cities. Land promoters and speculators liked to use the basic gridiron because of the ease of layout and surveying, the ease of obtaining a legal description, and the ease of merchandising the subdivided properties. The gridiron street pattern was also viewed as a means for facilitating the buying, selling and improving of real estate. Some of these towns featured gridirons which were built in conjunction with Indian burial mounds, or contained the Masonic Lodge emblem in the total street design, or focused the streets toward the center of the town for religious purposes.

New forms of transportation have also influenced the design and layout of streets and highways in America. Railroads, electric streetcars, and cable cars have all played their part in shaping urban America but the invention of the automobile has had the biggest impact on the design and layout of streets and highways in cities. The freedom and convenience of the automobile stimulated the creation of a nation-wide system of highways and freeways. Congestion, traffic accidents, and pollution forced communities to make changes in the design and layout of local street systems. Suburbs took on new looks

as well as curvilinear streets, loop streets and cul-de-sacs were developed and refined. The automobile has completely dominated the design and layout of streets and highways in America during the twentieth century.

B. CONCLUSIONS

Knoxville's street and highway system is 192 years old. During these two centuries we have seen it grow from a tiny sixteen-square block community with a symmetrical gridiron street pattern to a city with a wide variety of streets and street patterns. Knoxville's street and highway system is a refleciton of that growth. Parts of the city's street patterns are as old as the town itself while other are only days and weeks old. However, all of these streets and street patterns must function under at least current transportation needs and conditions. Where they do not, problems exist.

Knoxville's street and highways system has problems. Most of these troubles stem from the fact that the street and highway system has not been able to adapt to change. Conditions in the urban environment change while streets and highways remain the same. This lack of flexibility makes street and highway design and layout an issue that is becoming more important every day in Knoxville.

Why did Knoxville develop troubles with its street and highway system? The city's forefathers did not make the necessary physical and operation changes in the streets and street patterns over time to meet current and projected future needs and conditions. This lack of planning and foresight is evidenced in the large amount of money that

was recently spent to make drastic adjustments in the city's street and highway system, particularly the Interstate highways. It would appear that the lessons of proper city planning were never learned or ignored completely.

Knoxville's street and highway design problems began innocently enough when the town was founded in 1791. The city's first street pattern was a gridiron located on portions of a steep bluff overlooking the Tennessee River. Land speculation and promotion by Captain James White influenced his choice for a gridiron despite the known troubles of locating a city in rugged topography. White also saw the need of locating the streets adjacent to the river for trade and protection purposes.

Early expansions of the city's boundaries offered the promise of an eventual well-planned and prosperous city. New streets were logically tied into the existing gridiron street pattern. But this did not last. Knoxville's early growth saw the development of a variety of street patterns in communities surrounding the city. Each of these communities developed their street systems independently because they were separate incorporated towns. Connections of street systems between these suburban communities was not viewed as crucial because they were tied into Knoxville via the roads and streetcar lines which radiated from the city.

Knoxville's suburban communities developed street patterns which included the gridiron, organic, and combinations of both. Most of the communities developed their streets and street patterns on some of the worst terrain in the area, separated by the valleys, creeks and

streams, and railroad lines which criss-crossed the city. These natural and man-made barriers further isolated Knoxville from these suburbs until the city decided to annex additional territory. Even then, the physical gaps in the street system remained for years until development tied these areas together.

During Knoxville's first hundred years of existence, the street system reflected the independent and ad-hoc growth and development which had taken place. It developed relatively separately from the growth and patterns of other cities in the United States and the rest of the world. Not very many innovative concepts in city street and highway design were ever tried in Knoxville. Knoxville's claim to fame regarding street and highway design would be the creation of the state's first expressway, and later, the infamous freeway interchange, Malfunction Junction.

Knoxville's street and highway system also felt the impact of the development of the electric streetcar and the automobile. Each of these modes helped Knoxville's street system expand in a variety of directions as it became easier to reach the Central Business District from farther distances. Street patterns were often designed or adjusted to connect with the tracks or highways leading into town. The overlay of the Interstate highways in Knoxville has significantly altered the layout and function of the total street system by creating islands of development similar to the days when Knoxville experienced its first suburban growth.

The growth and popularity of the automobile pointed out the many deficiencies in Knoxville's street and highway system.

Congestion, accidents and other urgent problems occurred when the automobile was driven on a street system designed for the slower and more flexible movements of man and beast. Intersection and street design problems were understood as far back as 1927 when Harland Bartholomew and Associates developed the city's first comprehensive street plan but these improvements took as long as fifty years to be implemented.

The design and layout of Knoxville's Interstate highways also took many years to be completed. It is felt that much of this time was spent in political maneuvering by local businessmen and elected officials who wanted these facilities close to the Central Business District and the 1982 World's Fair. Recent reconstruction has brought portions of these facilities up to current design standards with some flexibility to meet future needs and conditions.

Knoxvillians' desire to live in the suburbs lead to the development of new street patterns in the 1950's, 1960's, and 1970's. Curvilinear streets with mixtures of loop, dead-end and cul-de-sac streets were designed to prevent neighborhood intrusion and increase safety. This movement to the west placed a heavy burden on the antiquated Interstate highway and arterial street systems forcing major improvements over the last decade.

Knoxville's suburban street systems have also been poorly designed. Most of these design problems have been caused by lax zoning and subdivision regulations. Inadequate planning of land use and transportation/circulation needs have caused many headaches in the improvement of the suburban street network. Dedication of land

adequate for future expansion of roadway facilities have typically not followed the prescriptions of Knoxville's Official Maps. Although individual residential subdivisions have usually been adequately designed for their traffic needs, problems have developed where they are joined into regional and sub-regional collector streets and arterials.

Knoxville's street and highway system evolved slowly into its present configuration. Many factors have influenced the design and layout of this network. Many mistakes were made in the design of the street and highway system. These problems have been reduced through the millions of person-hours and dollars that have been spent in its development and redevelopment, with more predicted for the future.

In thoroughly examining a portion of Knoxville's street and highway system, a number of major and minor problems still exist in the layout of the street and highway system. It is felt that these design difficulties are representative of the design and layout of the total street and highway network in Knoxville. The case study investigation also provided background information as to the reasons why the street and highway system developed in its present manner.

What does the future hold for Knoxville's street and highway system? As in the past, this is very difficult to predict. Given the ever-changing technical world which surrounds us, it would not be surprising to see new forms of transportation developed. These new transportation technologies could require new facilities to operate on, but in all likelihood, this will not happen. Since Knoxville has spent hundreds of millions of dollars, maybe even billions of dollars,

on the design and layout of its street and highway system, it would seem prudent to maintain and improve this investment. As Knoxville's street and highway system continues to grow in one form or another in the coming decades, it will be important to properly design these facilities to meet current and future needs. Flexibility in design and an awareness of a changing urban environment will be keys to street and highway planners in the decades to come. Learning from past mistakes and accomplishments should be the emphasis of street and highway planning. Since a significant portion of urban development today requires the design and layout of streets and other forms of movement space, this land must be designed to its maximum potential. We owe it to ourselves to see to it that this happens.

What can street and highway planners do to ensure that these facilities are adequately designed to meet current and future transportation needs, and avoid the mistakes that have occurred in the past?

1. Street and highway planners must thoroughly understand the important relationship between land use planning and transportation planning.

2. Street and highway planners must be knowledgeable of the history of street and highway planning and design to understand the motivations of past street planning activities in order to effectively plan future facilities and networks.

3. Street and highway planners must be aware of changing or new transportation technologies in order to plan for the specific needs and requirements of those technologies.

4. Street and highway planners must help develop strong subdivision and zoning requirements that allow for flexibility in design but provide for the basic current and future transportation needs.

5. Street and highway planners must continue to improve the existing street and highway system to at least current design standards.

6. Street and highway planners must be cognizant of the impacts of street and highway design and layout on existing and future natural and man-made systems.

7. Street and highway planners must be able to design facilities that are efficient in their function and their use of land.

8. Street and highway planners must understand that the urban and rural environment is dynamic in nature; therefore, a comprehensive planning process must be established in order to plan for these changing conditions.

9. Street and highway planners must actively encourage the general public to be involved in the planning and design of street and highway facilities.

Street and highway planning and design is a complex field of study and practice. The nine guidelines listed above will aid the street and highway planner in making rational street design decisions. These guidelines will allow the individual or agency to consider all of the many important factors which affect street and highway planning and design. As this paper has shown, very few cities, including Knoxville, have had the foresight to consider all of the factors

necessary in good street and highway planning and design. The art and science of planning street and highway systems will become critical in the future as the costs of these facilities continue to climb. Planners must accept the challenge of successfully designing a street and highway network which will incorporate the efforts from past generations with new concepts and directions in the decades ahead.

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APPENDIX

SECTION 18. *Improvements in Unapproved Streets.* BE IT FURTHER ENACTED, That the municipality shall not accept, lay out, open, improve, grade, pave, curb, or light any street, or lay or permit water mains or sewers or connections to be laid in any street, within any portion of the territory for which a major street plan shall have been adopted, unless such street shall have been accepted or opened as, or shall otherwise have received the legal status of, a public street prior to the adoption of such plan, or unless such street corresponds with a street shown on the official master plan or with a street on a subdivsion plat approved by the planning commission or with a street on a street plat or official street map made by and officially adopted by the commission. Council may, however, accept any street not shown on or not corresponding with a street on the official master plan or on an approved subdivision plat or an official street plat or the official map, provided the ordinance or other measure accepting such street be first submitted to the municipal planning commission for its approval and, if approved by the commission, be enacted or passed by not less than a majority of the entire membership of council, or if disapproved by the commission. be enacted or passed by not less than two-thirds of the entire membership of council. A street approved by the planning commission upon submission by council, or accepted by a two-thirds vote after disapproval by the planning commission, shall thereupon have the status of an approved street and part of the official street map as fully as though it had been originally approved or platted by the planning commission.

SECTION 20. *Reservation of Locations of Mapped Streets for Future Public Acquisiton.* BE IT FURTHER ENACTED, That the planning commission is empowered, after the adoption of a major street plan of the territory within its platting jurisdiction, to make or cause to be made, from time to time, surveys for the location of the lines of a street or streets in any portion of such territory and to make a plat of the area or district thus surveyed, showing the land which it recommends to be reserved for future acquisition for public streets. The commission, before making its final recommendations as to such plat, shall hold a public hearing thereon, notice of the time and place of which, with a general description of the district or area covered by the plat, shall be published once not less than ten days previously to the time fixed therefor. After such hearing, the commission may transmit such plat to the council, together with the commission's estimates of the time or times within which the lands, shown on the plat as street locations, should be acqured by the municipality. Thereupon, by resolution, council may approve and adopt or may reject such plat, or may modify it with the approval of the planning commission, or, in the event of the planning commission's disapproval, council may, by a favorable vote of not less than two-thirds of its entire membership, modify such plat and adopt the modified plat. An attested copy of the plat so adopted shall be transmitted to and filed with the recorder of deeds of the county within which the land is located. Council may then by ordinance authorize and direct the institution of condemnation proceedings for the reservation for future taking or acquisition for public use of the land affected, fixing the time for which such street locations shall be deemed reserved. Such approval and adoption of a plat, and such ordinance, however, shall not be deemed the opening or establishment of any street, nor the taking of any land for street purposes nor for public use, nor as a public improvement, but solely a reservation of the street locations established thereby for the period specified, for future taking or acquisition for public use. The commission may, at any time, negotiate for or secure from the owner or owners of any such lands, releases of claims for damages or compensation for such reservations or agreements indemnifying the municipality from such claims by others, which releases or agreements shall be binding upon the owner or owners executing the same and their successors in title. At any time before the award of compensation, as hereinafter provided for, and after a hearing before the commission, similar to that required in the case of the orginal plat, council may order changed any plat previously adopted, cause the new plat to be filed, and direct, by proper ordinance, the amendment of the condemnation proceedings to conform thereto. At any time council may by proper ordinance abandon any reservation and shall so certify to the recorder of deeds.

Source: Harland Bartholomew and Associates, A Comprehensive City Plan, Knoxville Tennessee (St. Louis, Missouri: Harland Bartholomew and Associates, August 1, 1929), pp. 227-228.

VITA

Gregory Lee Errett Was born in Santa Barbara, California, on December 6, 1955. He attended elementary schools in that city, and was graduated from Santa Barbara High School in 1974. In June, 1979, he received a Bachelor of Science degree in City and Regional Planning from the School of Architecture and Environmental Design at California Polytechnic State University, San Luis Obispo.

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