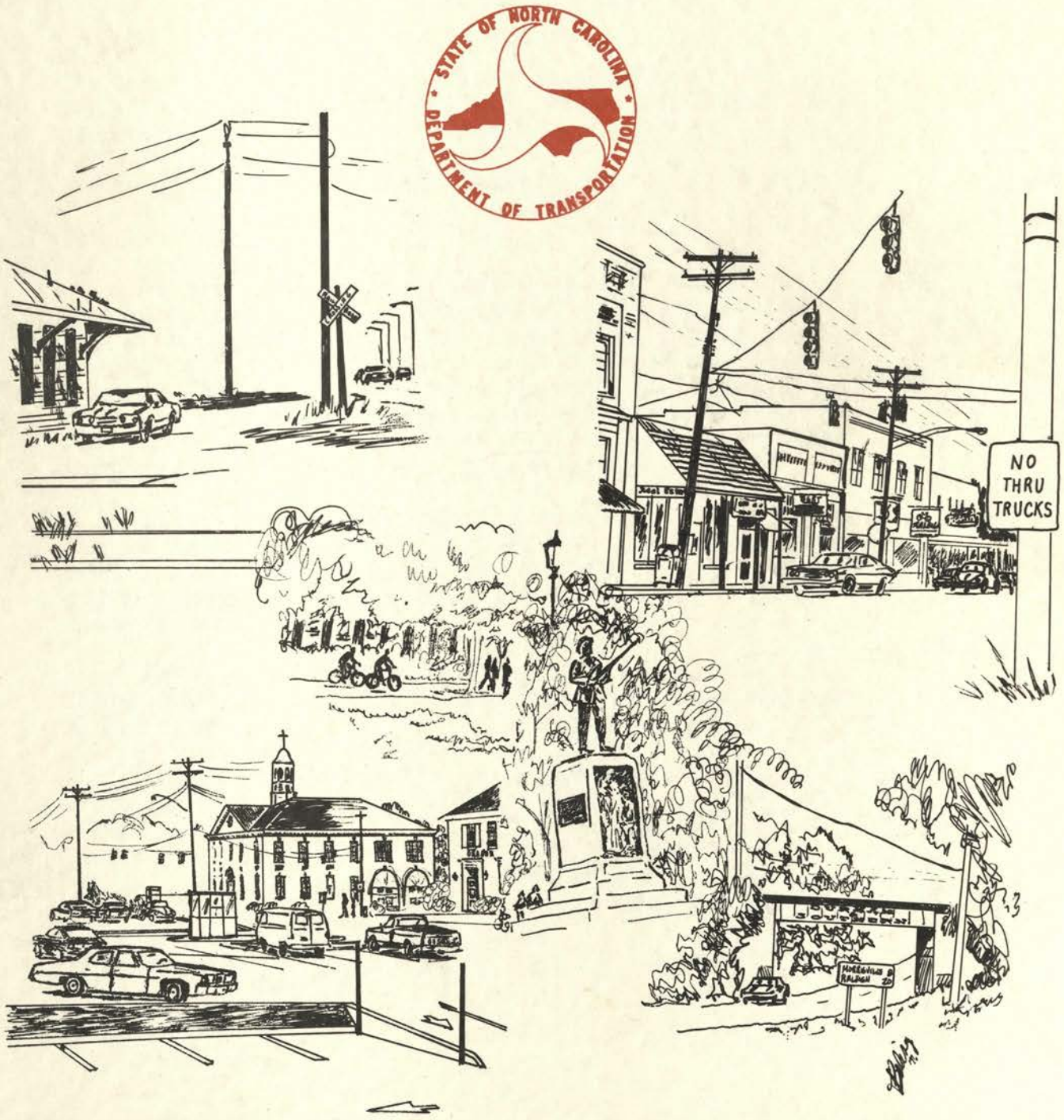
Chapel Hill - Carrboro
1976

CHAPEL HILL - CARRBORO TRANSPORTATION PLAN

[THOROUGHFARE]

DIVISION OF HIGHWAYS



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION AND HIGHWAY SAFETY
RALEIGH 27611

JAMES E. HOLSHOUSER, JR.
GOVERNOR

DIVISION OF HIGHWAYS

March 15, 1976

The Honorable Ruth West, Mayor of Carrboro
The Honorable James C. Wallace, Mayor of Chapel Hill
Members of the Boards of Aldermen
Members of the Planning Boards
Towns of Chapel Hill and Carrboro

Gentlemen:

We are pleased to submit herewith the Chapel Hill-Carrboro Thoroughfare Plan Report giving a description of the plan and describing the inventory, analysis, and other supporting data. This Thoroughfare Plan was developed as a guide for solving the existing and anticipated traffic problems within the Chapel Hill Urban Area. The basis for the plan was a series of traffic, economic, population and land use studies of the area.

It is emphasized that the proposed thoroughfare system is a balanced network and is completely dependent, one part upon the other. A high degree of cooperation and coordination must prevail as the Thoroughfare Plan is implemented.

We wish to express our sincere appreciation for the fine cooperation extended us during the preparation of this report.

Cordially yours,

Billy Rose
State Highway Administrator

BR/pr

CHAPEL HILL-CARRBORO THOROUGHFARE PLAN

Prepared for
The Towns of Chapel Hill & Carrboro

in cooperation with the
Federal Highway Administration
of the
United States Department of Transportation

by the

Planning and Research Branch
Division of Highways
North Carolina Department of Transportation

March, 1976

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I. INTRODUCTION

Historically, thoroughfare planning began in the Chapel Hill - Carrboro area with the development of the Babcock Plan in 1955 and the Horn Plan in 1959. The present thoroughfare plan (adopted by the towns of Chapel Hill and Carrboro in 1968 and by the N. C. State Highway Commission later in 1968) maintained many of the proposed elements from the Babcock and Horn Plans while giving consideration to those developments which had altered traffic volumes and patterns in the post Babcock era and also incorporated community views on these proposals.

Those projects that have been implemented under the 1965 adopted thoroughfare plan are:

(1) Estes Drive - east extension south of University Mall.

(2) Estes Drive - (SR 1780 - West extension) south of the airport.

(3) Umstead Drive - extension tying to SR 1780

(4) Piney Mountain Road - extension

(5) SR 1843 - extension (at Seawell Elementary School), presently under construction and will connect to SR 1780 (Estes Drive) south of the airport.

The current update of the mutually adopted plan is another step in a series of attempts to deal with the transportation needs of Chapel Hill, Carrboro, UNC, and the nearby surrounding areas. Essentially the recommended plan as discussed in this report is a revision of the adopted thoroughfare plan. Citizen input from public forums and planning board suggestions and recommendations served as a basis for this revision.

A review of the agreement between the North Carolina Highway Commission and the Town of Chapel Hill points out that the Chapel Hill Planning Department had the responsibility of projecting all socio-economic data to the design

year (1995). The Planning and Research Branch of the Division of Highways had the responsibility of converting the projected socio-economic data to trips and modeling resulting traffic patterns and volumes according to the methodology (computer techniques) prescribed by the Federal Department of Transportation. Therefore, the primary role played by the Thoroughfare Planning Section in the Chapel Hill - Carrboro Thoroughfare Plan update was that of furnishing technical expertise and support in modeling traffic flow and incorporating the planning input from individual citizens, citizen groups, UNC, and the planning boards and staffs from both towns for the development of the revised plan.

Thus, the recommended thoroughfare plan as presented in this report had its' genesis and subsequent development at the local level. Of course some compromise is necessitated in any transportation plan; however, compromise of citizen planning input for this plan occurred only when it was in direct conflict with tried and proven transportation planning methodology.

Typically, the urban street system occupies 25 to 30 percent of the total developed land in the urban area. Since the system is permanent and expensive to build and maintain, much care and foresight are needed in its development. Thoroughfare planning is the process used by public officials to assure the development of the most logical and appropriate street system to meet the existing and future travel desires within the urban area.

There are many and varied benefits to be derived from thoroughfare planning, but the primary objective is to enable the urban street system to be progressively developed in a manner which will adequately service anticipated future travel demands. In addition, the thoroughfare plan should embody those details of good urban planning necessary to present a pleasing and efficient urban community. The location of present and future population and commercial-industrial enterprises affect major street and highway locations; and conversely, the location of major streets and highways within the urban area will influence the urban development pattern. This interaction requires that the thoroughfare plan be compatible with other components of the urban planning and development program.

Some of the major benefits to be derived from thoroughfare planning are:

(1) A minimum amount of land will be required for street and highway purposes.

(2) Each street can be designed for a particular purpose which leads to stability of traffic and land use patterns.

(3) Because each street is designed for a particular purpose, a substantial savings can be realized in street construction programs and street maintenance costs.

(4) Local citizens will know which streets will be developed as major thoroughfares and thus will have assurance that their residential street will not one day become a major traffic carrier.

(5) Land developers will be able to design their subdivisions so that subdivision streets will function in a non-conflicting manner with the overall plan.

(6) City officials will know when improvements will be needed and can schedule funds accordingly.

(7) School and park officials can plan and locate their facilities in desirable places with knowledge of land use and street system stability.

(8) By understanding the thoroughfare plan and realizing where and approximately when necessary street widening and construction will occur, much can be done to eliminate irretrievable damage to property values and community appearance as is sometimes associated with major street widening and construction.

This report is principally concerned with thoroughfare planning for the Chapel Hill-Carrboro Urban Area and sets forth a functional system of thoroughfares required to serve the anticipated traffic and land development needs for the next twenty years. Recommended improvements are grouped into four priority groups and some administrative and legal measures are explained to assist the municipalities in implementing the plan.

Design requirements for the streets comprising the

thoroughfare system are indicated in terms of typical cross sections showing the number of travel lanes necessary to serve anticipated 1990 and 1995 traffic movements. The travel lane requirements were developed from studies of population, economy, land use, and traffic in the study area. It is emphasized that the proposed thoroughfare plan was developed based on the anticipated growth of the urban area as explained in this report. Actual growth rates and patterns may differ somewhat from those logically anticipated. Thus, it may be desirable to accelerate or retard the development of proposed thoroughfares or to make revisions in the proposed plan commensurate with future variations in anticipated urban development.

II. PRINCIPLES OF THOROUGHFARE PLANNING

Objective

Roadways perform a vital service for the community. Roadways directly influence the vitality of an area in that they provide the avenue for the exchange of goods, services, and people within the community and between adjacent communities. Roadways influence the size and shape of lots and often the type of development found thereon. Roadways, too, provide convenient boundaries for the separation of various types of land uses.

Roadways provide two distinct services - traffic service and land service. Basically, these two services are incompatible. Service to adjacent land will suffer at the expense of moving traffic and vice versa. At low traffic volumes, these two services may exist jointly without serious conflict, however, as traffic volumes reach higher levels, attempting to provide both of these services with one facility causes inconvenient and hazardous traveling conditions at their interface. Thus it is imperative that roadways providing the service of moving large numbers of vehicles be separated from those roadways providing service to active land uses.

The objective of thoroughfare planning is to provide a network of roads that will blend with the environment and at the same time permit the safe and orderly movement of traffic from point of origin to point of destination with reasonable speed, comfort, and convenience. Since the planning area in general has a basic economy that is primarily education and service oriented, this above objective is necessary to the continued development and well being of the area.

To attain this objective economically, it is necessary to divide the road network into several categories of streets, each category designed to perform a specific function (see Figure 1). Discussion of these various classifications follow.

Street Classifications

Major Thoroughfares

The major thoroughfares are the principal traffic carriers of the urban area. Their function is to move both intra-urban and inter-urban traffic. These streets may also provide access to abutting property, but their primary function is to carry traffic. The service to abutting property should be limited since uncontrolled access lowers the capacity of the thoroughfare to carry traffic, and each access point becomes a danger zone and an impediment to traffic flow. For the same reasons, on-street parking should be discouraged along major thoroughfares. Traffic volumes control the design of major thoroughfares, which may range from two-lane roads carrying moderate traffic volumes to multi-lane expressways carrying heavy volumes.

Minor Thoroughfares

The minor thoroughfares function as collectors and distributors of traffic between local access streets and major thoroughfares. They may also be used to supplement the major thoroughfares by carrying certain minor through traffic movements. They should ordinarily be designed to serve only a limited area, allow access to abutting property, and permit on-street parking. Right-of-way and travel lane requirements will naturally depend upon traffic volumes; but as a rule, right-of-way widths should not be less than 70 feet.

Local Access Street

Local access streets provide service to abutting property. Since local access streets are intended to have only small service areas, volumes on them are usually light. The following breakdown of local access streets is based on the type of abutting land use that they serve.

Residential Streets - Residential streets provide access to abutting residential property. Through traffic movements should be discouraged by designing residential streets as short loops, curvilinear streets or cul-de-sacs. These streets should have two traffic lanes and may have parking on one or both sides. Residential streets should have a minimum right-of-way of 60 feet.

Commercial Streets - Commercial streets provide access to abutting commercial property. These streets are intended to circulate traffic in commercial areas and to provide direct access to off-street parking facilities. Commercial streets should have at least two travel lanes, with provisions for curb parking if desirable and feasible.

Industrial Streets - Industrial streets provide access to abutting industrial development. Since industrial streets normally handle a large portion of trucks, they should be adequately designed to accommodate such vehicles. At least two traffic lanes should be provided with additional parking and loading zones as required. Industrial streets should have a minimum right-of-way of 60 feet.

Idealized Major Thoroughfare System

An idealized thoroughfare system (see Figure 1) contains a coordinated network of major thoroughfares. These major thoroughfares, as previously described, are the principal traffic carriers of the urban area, and as such, deserve special mention. In the idealized concept, urban travel desires are satisfied by a radial-loop major thoroughfare system. The basic components of this system follow.

Radial Streets

Radial streets provide relatively direct routes between the urban core and outlying areas. They are the major traffic carriers, usually fanning out from the central business district to the periphery of the urban area. Accessibility between the core of the urban area and the periphery is directly related to the number and quality of the facilities. Most urban cores require a well-structured set of radial streets in order to prosper.

Crosstown Streets

Crosstown streets can conceivably act as radial streets, but they are meant to differ in one major respect. While radials should provide for traffic movements between the urban core and the periphery, crosstowns should handle movements having origins and destinations on opposite sides of the urban core. Crosstown streets should skirt the edge of the core in order to prevent unnecessary travel and congestion in the downtown area.

Loop System Streets

Loop streets usually encircle the urban area. They are

intended to handle traffic between outlying sections of the city and act as connectors between radials. Loop streets help to relieve central area congestion and shorten travel times between suburban areas, but they do not necessarily carry heavy volumes of traffic. The size of the urban area determines the number of loops required, while the intensity of land development controls the spacing between loops, generally one to one and a half miles apart.

Bypass

A bypass functions to carry traffic across the edge of an urban area, thus diverting such traffic from the central area. A bypass helps to expedite through travel movements and improve traffic conditions on the urban street system. Bypasses are generally designed to rural highway standards with some control of access. Occasionally a lightly traveled bypass can be designated to function as a portion of an urban loop.

Application of Thoroughfare Planning Principles

The preceding sections of this chapter have described the elements of an idealized thoroughfare system. Ideal situations, however, are seldom encountered in normal practice. Thoroughfare planning must usually be performed within the context and realities of long-established communities. Street location, design, and performance is often controlled by existing and anticipated conditions in the urban area. From a practical viewpoint, it is important that the existing street system, which represents a substantial monetary investment, be incorporated into the thoroughfare plan and be used to maximum advantage.

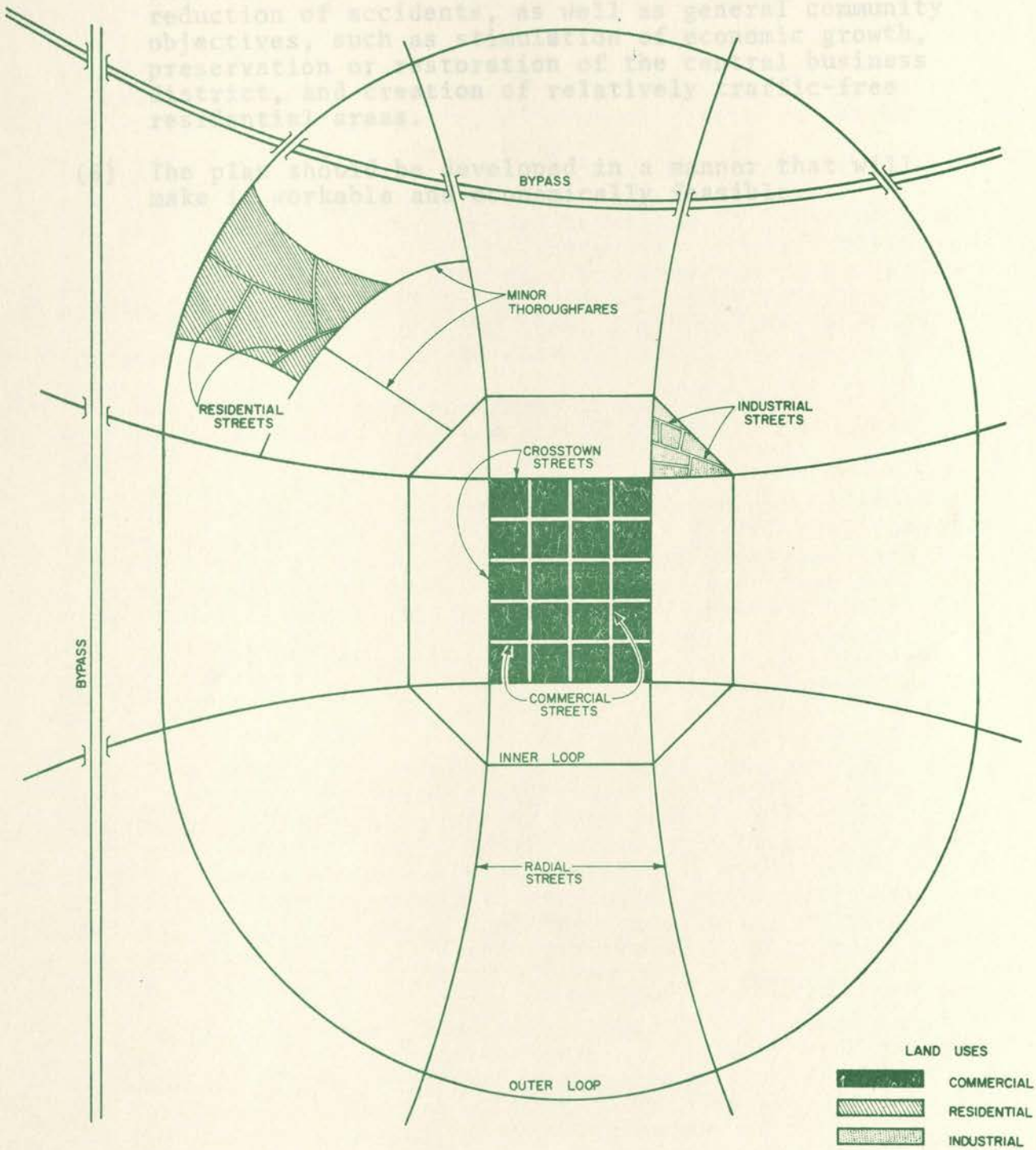
The value of the idealized thoroughfare system lies in the fact that it embodies certain planning principles which can be referred to during the planning process. The following principles should be followed as closely as possible:

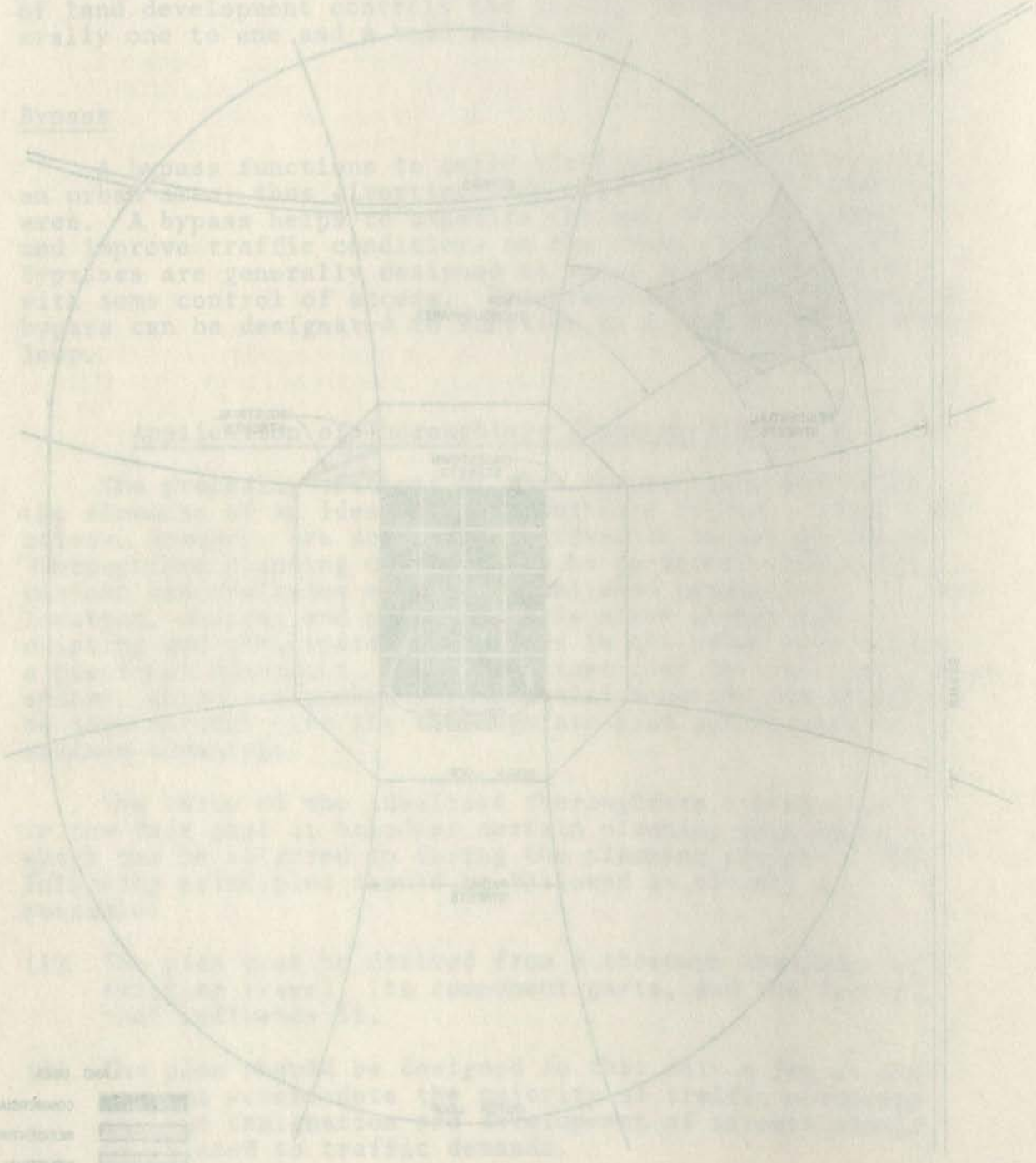
(1) The plan must be derived from a thorough knowledge of existing travel, its component parts, and the factors that influence it.

(2) The plan should be designed so that only a few of the streets accommodate the majority of traffic movements, and the designation and development of streets should be related to traffic demands.

FIGURE I

IDEALIZED THOROUGHFARE PLAN





(3) The plan should conform to existing land development patterns and encourage appropriate development in the future.

(4) The plan should consider user objectives, such as shorter travel times, lower operating costs, and reduction of accidents, as well as general community objectives, such as stimulation of economic growth, preservation or restoration of the central business district, and creation of relatively traffic-free residential areas.

(5) The plan should be developed in a manner that will make it workable and economically feasible.

III. CHAPEL HILL-CARRBORO --- PAST, PRESENT, AND FUTURE

Chapel Hill-Carrboro and the Region

The towns of Carrboro and Chapel Hill are located in the southeastern corner of Orange County, not far from the Chatham and Durham County lines. The location of the Chapel Hill-Carrboro area in relation to major cities and highways is shown in Figure 2. Rail service to this area is, through Durham (10 miles distant), via Norfolk & Southern, Durham & Southern, and Southern Railroads, and through Raleigh (30 miles distant), via Seaboard Coastline Railroad. Chapel Hill-Carrboro is served by the University's Horace Williams Airport with runways of 5000 feet and they are in close proximity to the Raleigh-Durham Airport, only 16 miles away. Carolina Trailways and Queen City Buslines service the area with a modern up-to-date bus terminal.

The primary routes providing Chapel Hill-Carrboro with regional highway service are US 15-501, NC 54, NC 86, and NC 87.

Founded in 1789, Chapel Hill was chosen as the site of the University of North Carolina, the first state supported university in the Country, and has developed into a typical university town. The name was taken from New Hope Chapel of the Established Church of England, which was located at the intersection of two major transportation routes of the day, the east-west route from New Bern to Salisbury and the major road south from Petersburg, Virginia.

As a center of learning, Chapel Hill has been able to attract some of the best intellectual and creative minds and progressive thinkers of the nation without loosing its southern tradition and cultural heritage. The population is a blend of intellectuals and merchants, artists and housewives, writers, students and world famous personages. The University has been a dominant force in the shaping of the community in the past and is expected to continue so in the future.

Carrboro is contiguous with Chapel Hill. Hence, many of the social and cultural elements of Carrboro are involved with and often parallel the same elements in Chapel Hill. Carrboro's past existence as a mill town has been left behind. The town is now a rapidly growing community of residences and apartments and is developing a character of "bedroom" suburb to Chapel Hill. The two towns have grown together

and in many considerations have become one community with two governing bodies. The University is a dominant force affecting both towns.

Factors Affecting Transportation

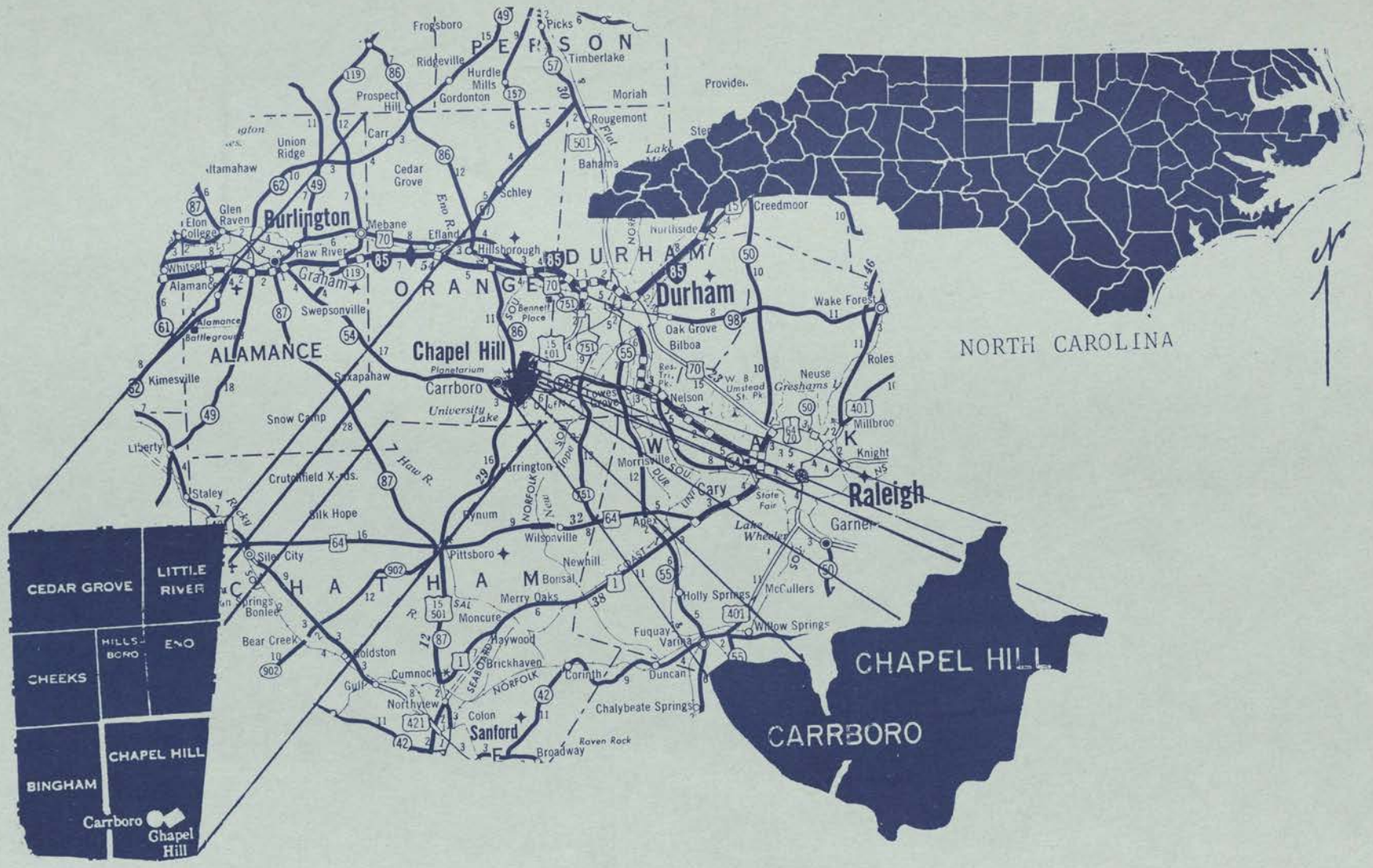
In order to conduct a transportation study, traffic and existing transportation facilities must be inventoried and the future traffic demand estimated. To accomplish this, the study area has to be defined and delineated. The study area is the area in which, during the planning period, development directly related to Chapel Hill-Carrboro is expected to occur. Since the current planning year is 1995, this area may also be called the 1995 Chapel Hill-Carrboro Urban Area. This "Planning Area" is shown in Figure 3 along with the traffic zones which were established for purpose of analysis.

Travel desires within the Urban Area are determined by the interaction of many factors, including the distribution and density of population; the extent and location of commercial, industrial, and residential activity; and the overall level of the economic factors. By studying and estimating the future trends of these factors, future travel desires can be estimated. For this study, travel projections to both 1990 and 1995 were accomplished in order to provide a basis for estimating design traffic for future projects. The design year for individual projects must be precisely 20 years.

In predicting travel desires within the Planning Area, population and employment trends were projected to both 1990 and 1995. Changes in vehicle ownership during the planning period were estimated and the most probable 1995 land use patterns were established. From these projected variables, the 1990 and 1995 internal, external, and through traffic movements were developed.

Population

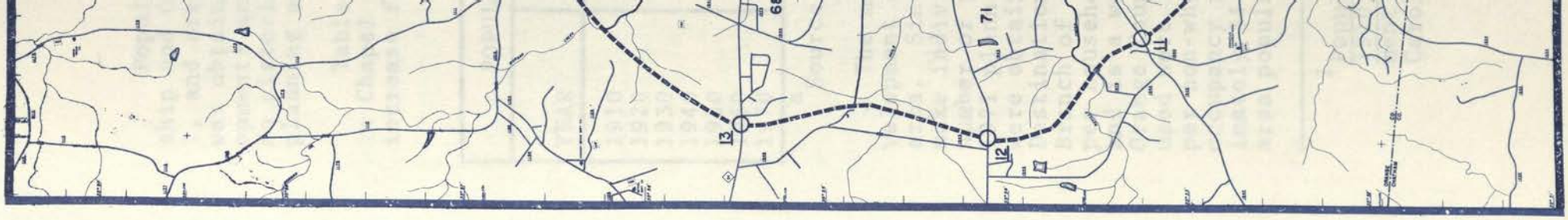
Travel is directly related to people and the volume of traffic on any given section of roadway is closely related to the size and distribution of the population which it serves. Because of this relationship, one of the basic steps in planning a transportation system is an in-depth population study. Other studies including economic and land use are also used to arrive at design year traffic flow patterns.



TOWNSHIPS

FIGURE 2

GEOGRAPHIC LOCATION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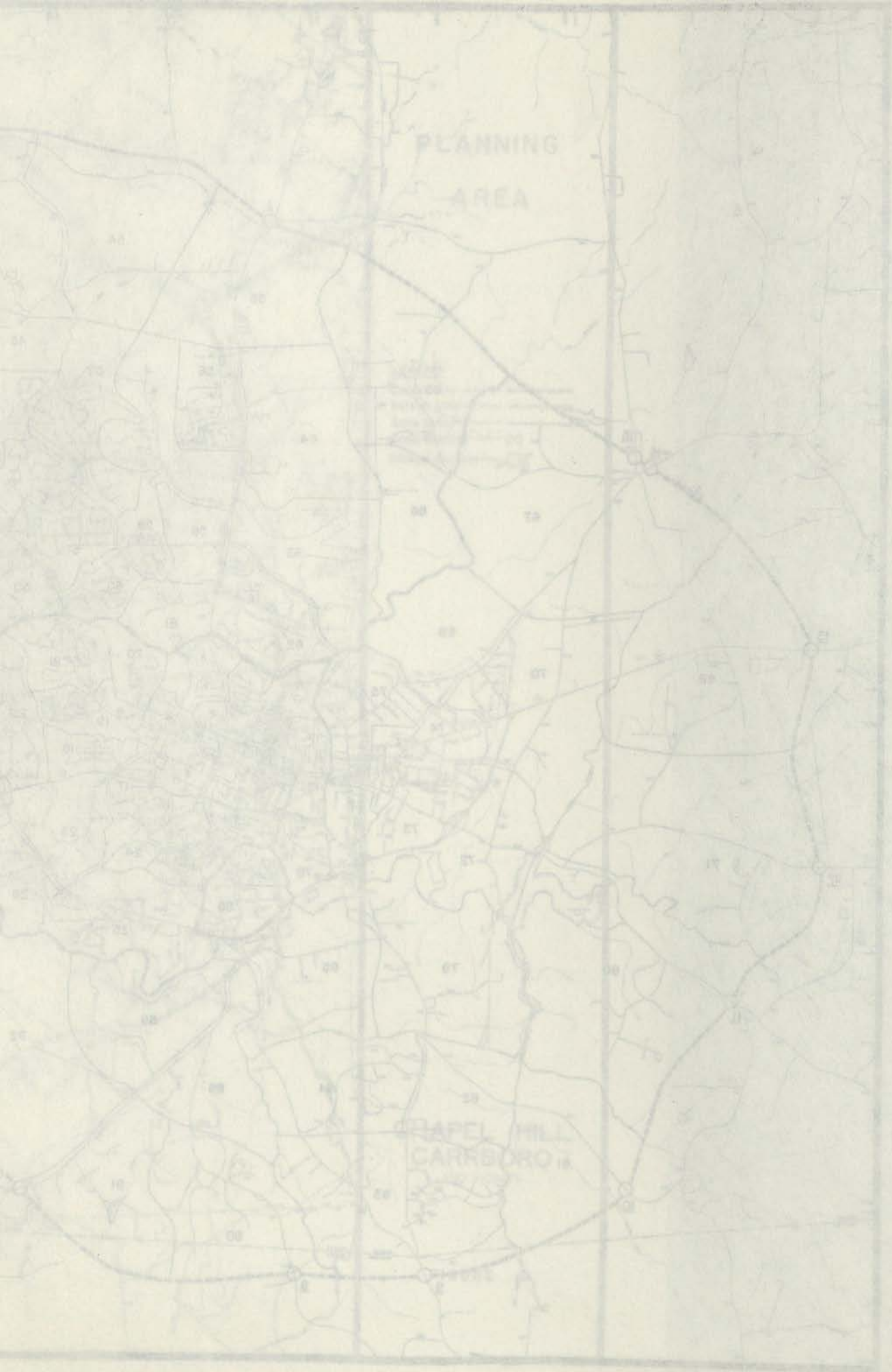
CARRBORO
AND VICINITY
FIGURE 3


PLANNING
AREA
CHAPEL HILL
CARRBORO

Population trends for Orange County, Chapel Hill Township and Chapel Hill-Carrboro since 1910 are shown in Table 1, and are graphically illustrated in Figure 4. This data was obtained from the Department of Conservation and Development[1] and the U. S. Bureau of the Census, July, 1971. No historic census data exists for the Chapel Hill-Carrboro planning area because it is not a politically defined unit.

Table 1 shows a steady moderate population increase in Chapel Hill and Carrboro from 1930 to 1960 and a marked increase from 1960 to 1970.

TABLE 1

POPULATION TRENDS IN THE CHAPEL HILL-CARRBORO AREA[a]

YEAR	CITIES OF CHAPEL HILL-CARRBORO	CHAPEL HILL TOWNSHIP	ORANGE COUNTY
1910	1,149	4,159	15,064
1920	2,612	5,317	17,895
1930	3,941	7,490	21,171
1940	5,109	8,903	23,072
1950	10,972	18,222	34,435
1960	14,570	25,030	42,970
1970	29,005	38,856	57,707

[a] Source: U. S. Bureau of the Census

The most important population projection for the development of the thoroughfare plan is that of the planning area. Since no historic data existed, it was necessary to make individual household counts and estimate the average number of persons per household to arrive at an acceptable 1971 planning area population figure. Household counts were obtained in conjunction with the 1971 Origin - Destination Survey conducted by the Planning and Research Branch of the Division of Highways. The number of persons per household was obtained from the 1970 Census of Housing and is a weighted average of the persons per household for Orange County and Chapel Hill. Thus, the occupancy rates used were 2.4 persons per white household and 3.6 persons per non-white household. From the household counts and occupancy rates, a 1971 planning area population of approximately 34,000 was reached. The estimated 1971 planning area population by traffic zone is shown in Table 2.

---

[1] Population of Counties and Minor Civil Divisions: 1910 - 1960, Department of Conservation and Development, Division of Community Planning; Raleigh, North Carolina, January, 1962.

TABLE 2

1971 & 1995 POPULATION DISTRIBUTION BY ZONE

Zone	Population		Zone	Population		Zone	Population		Zone	Population	
	1971	1995		1971	1995		1971	1995		1971	1995
1	29	29	27	1378	1378	53	259	547	79	115	946
2	254	320	28	2	625	54	26	393	80	181	717
3	-	-	29	-	-	55	100	370	81	32	192
4	-	-	30	-	-	56	459	713	82	69	451
5	507	572	31	118	261	57	90	601	83	547	608
6	253	182	32	60	205	58	4	238	84	356	774
7	554	560	33	146	317	59	158	218	85	10	835
8	551	944	34	24	334	60	286	409	86	115	521
9	1302	1320	35	58	276	61	98	518	87	163	254
10	1037	1048	36	245	414	62	862	1367	88	375	666
11	234	242	37	137	782	63	-	-	89	120	812
12	112	66	38	665	696	64	139	333	90	169	320
13	408	656	39	147	1422	65	300	321	91	63	292
14	1053	696	40	199	409	66	-	119	92	19	584
15	-	-	41	24	213	67	149	833			
16	-	-	42	108	378	68	269	595			
17	7	7	43	69	2426	69	161	514			
18	103	163	44	67	386	70	329	931			
19	422	649	45	36	547	71	97	708			
20	96	386	46	103	607	72	31	547			
21	641	829	47	41	839	73	983	1748			
22	274	376	48	773	713	74	749	874			
23	175	382	49	1116	1201	75	984	1152			
24	-	-	50	358	521	76	233	313			
25	523	1485	51	355	470	77	771	774			
26	60	60	52	293	324	78	1235	1432			
									TOTAL	33,800	58,833 [a]

[a]

With a planning area base year population estimate of 34,000 persons established, the next step is to project the base year data to 1995. These projections were made by the Chapel Hill Planning Department and are shown in Table 3 and graphically illustrated in Figure 4. The 1971 and 1995 population distribution by traffic zone is shown in Table 2.

TABLE 3

POPULATION PROJECTIONS FOR THE CHAPEL HILL-CARRBORO AREA[a]

	1970	1971[b]	1990[b]	1995[b]
Orange County	57,707	-	96,249	105,885
Chapel Hill Township	38,856	-	72,500	80,911
Cities of Chapel Hill - Carrboro	29,005	-	47,220	51,774
Planning Area	-	33,800	54,104	58,833

[a] Source: U. S. Bureau of the Census
[b] Estimated

Economy

One of the more important factors to be considered in estimating the future traffic or population growth of an area is the area's economic base. The number of employees and their income or purchasing power determines how much population can be supported in the area and the number of motor vehicles that will be locally owned and operated. Generally, as the family income increases, the number of vehicles owned and the number of vehicle trips per day generated by each household increases. Therefore, a thorough understanding of the factors making up both the basic and non-basic sectors of the economy is essential to an understanding of the traffic desires.

In 1969, according to the Bureau of the Census[2], the median income for families in Chapel Hill was $10,536; and in Carrboro $7,169. Both of these figures reflect an increase in median income of approximately $4,000 over the end of the previous decade. This increase may be attributable both to an overall increasing standard of living and to better job opportunities resulting from an expanding economy. Also, it should be noted that the median

[2] United States Census of Population 1970, North Carolina General Social and Economic Characteristics, United States Department of Commerce, Bureau of Census, Table 41, 42, and 44.

income of Chapel Hill is approximately $1,800 higher than that for Orange County and nearly $2,800 higher than the median income for North Carolina. An explanation of these high figures might be made from the fact that a very high percentage of the work force in Chapel Hill is employed in white-collar occupations. Another interesting fact is that in 1969 only 27.0 percent of those persons employed in Chapel Hill worked 50 to 52 weeks. This strongly reflects the seasonal nature of the employment opportunities found within the planning area.

To determine future traffic desires it is necessary to predict future employment. It was estimated that 12,250 people were employed in the Chapel Hill-Carrboro Planning Area in 1971. The estimate was arrived at by a field inventory of all commercial, institutional and governmental establishments in the planning area. The Chapel Hill Planning Department, using the 1971 employment data, made the employment projections to 1995. The 1971 and 1995 employment distribution by traffic zone is shown in Table 4.

Land Use

The generation of traffic on a particular street is very closely related to the manner in which adjacent land is used. Some types of land uses generate more traffic than do others. The attraction of different land uses varies with the intensity and spatial separation of the uses. It, therefore, becomes necessary to designate land uses by type for the purposes of transportation planning. An analysis of the distribution of existing land uses serves as a basis for forecasting future land use needs and the resulting travel patterns.

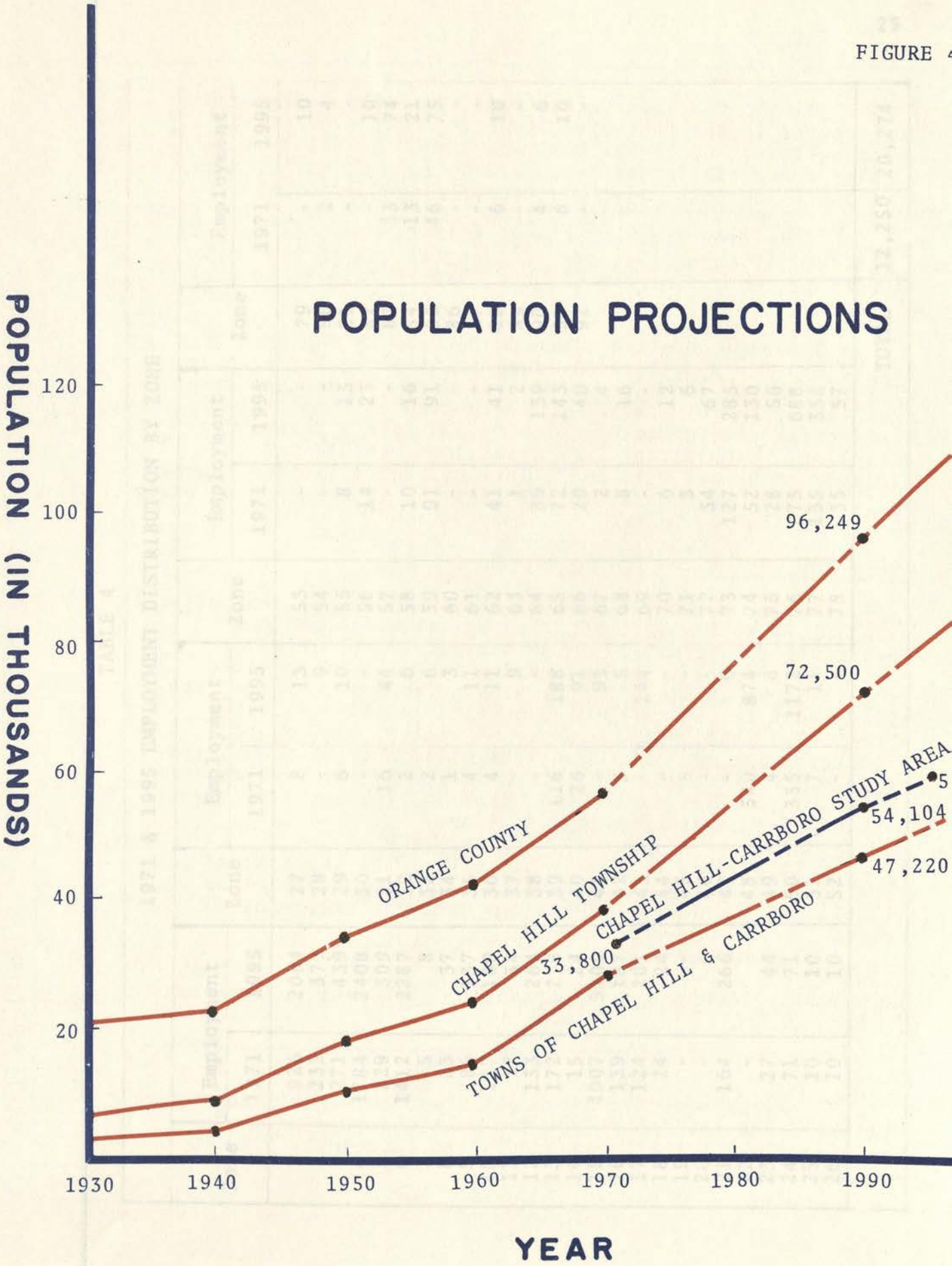
The 1971 land use data as shown in Figure 5, was obtained from the Research Triangle Regional Planning Commission and was updated by data collected in the 1971 origin-destination survey.

Figure 5 shows the University of North Carolina occupying four large sections of the planning area: one section has Kenan Stadium as its center, another section surrounds Horace Williams Airport, and the other sections are in the southeast and west portions.

Most of the industrial land usage is scattered through or near Carrboro.

A major commercial area in Chapel Hill is north of the central campus on Franklin Street and extends along Franklin

FIGURE 4


POPULATION PROJECTIONS
POPULATION (IN THOUSANDS)
120
100
80
60
40
20
1930
1940
1950
1960
1970
1980
1990
YEAR
ORANGE COUNTY
96,249
CHAPEL HILL TOWNSHIP
72,500
CHAPEL HILL-CARRBORO STUDY AREA
33,800
54,104
TOWNS OF CHAPEL HILL & CARRBORO
47,220

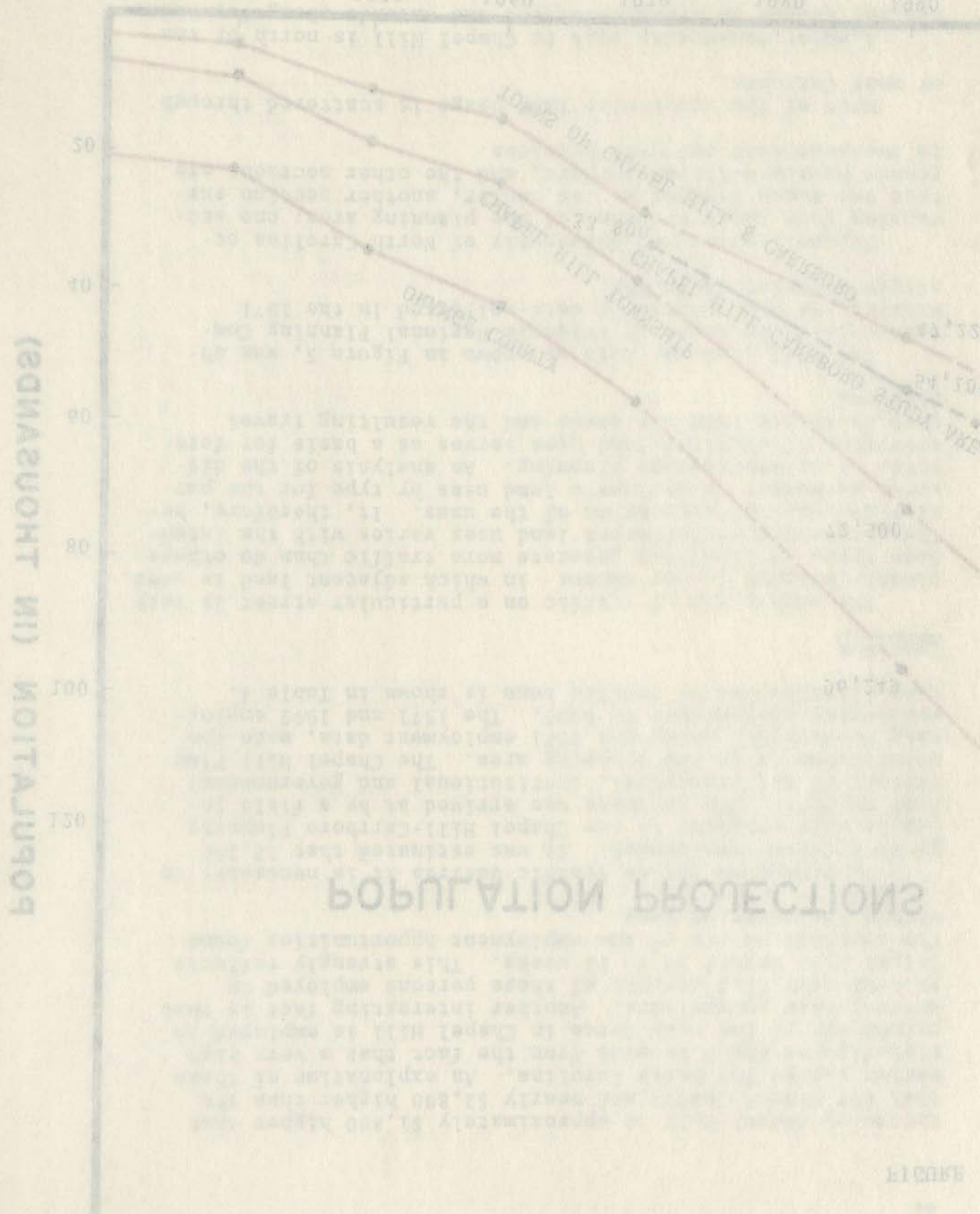

POPULATION (IN THOUSANDS)

TABLE 4

1971 & 1995 EMPLOYMENT DISTRIBUTION BY ZONE

Zone	Employment		Zone	Employment		Zone	Employment		Zone	Employment	
	1971	1995		1971	1995		1971	1995		1971	1995
1	926	2084	27	8	13	53	-	-	79	-	10
2	233	377	28	-	9	54	-	-	80	2	4
3	271	439	29	6	10	55	8	13	81	-	-
4	1784	2408	30	-	-	56	14	23	82	-	10
5	229	309	31	16	44	57	-	-	83	33	74
6	1412	2287	32	2	6	58	10	16	84	13	21
7	5	8	33	2	6	59	91	91	85	46	75
8	23	37	34	1	3	60	-	-	86	-	-
9	85	137	35	4	11	61	-	-	87	-	-
10	117	189	36	4	11	62	41	41	88	6	10
11	17	34	37	-	9	63	1	2	89	-	-
12	133	264	38	-	-	64	86	139	90	4	6
13	172	278	39	116	188	65	72	143	91	6	10
14	15	24	40	26	91	66	20	40	92	-	-
15	4007	5409	41	-	91	67	2	4			
16	139	187	42	3	5	68	8	16			
17	124	201	43	-	244	69	-	-			
18	24	24	44	-	-	70	6	12			
19	-	-	45	-	-	71	3	6			
20	-	-	46	-	-	72	34	67			
21	164	266	47	-	6	73	127	285			
22	-	-	48	540	874	74	52	130			
23	27	44	49	4	6	75	28	56			
24	71	71	50	355	1172	76	275	688			
25	10	10	51	7	11	77	135	338			
26	10	10	52	-	-	78	35	57			
									TOTAL	12,250	20,274

Street joining Carrboro on the west. Another large commercial center is the Eastgate-University Mall area at the intersection of US 15-501 Business and US 15-501 Bypass. Smaller commercial areas include Glen Lennox, Watts, Airport Road, The Oaks, Town and Country, and Eastowne.

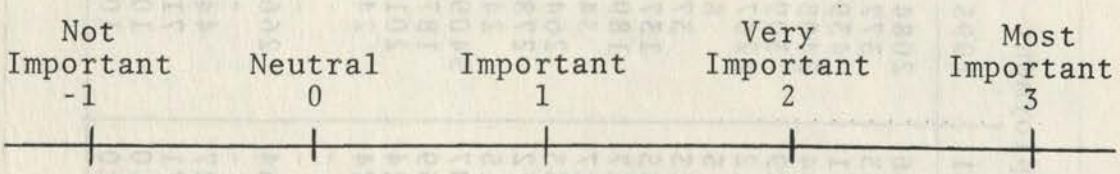
As seen from Figure 5 Chapel Hill-Carrboro is primarily a residential community, and residential use is the most important, and by far the largest, use of land to be considered.

A future generalized land use scheme is depicted by Figure 6. Strip commercial development along any highway will be limited to existing development. Commercial development taking the cluster form is expected to remain stable. Residential development is expected to take a westwardly direction. Significant industrial land use has not yet occurred in Chapel Hill and exists only on a limited degree in Carrboro. Future industrial land use is expected to occur only on a limited basis.

Goals and Objectives Survey

In order to obtain public attitudes toward transportation planning, a goals and objectives survey was completed during the spring of 1975. A total of 20 completed or partially completed survey questionnaires were received from citizens in the planning area. The objectives of the survey were to solicit public opinion in the following areas: (1) relative importance of various aspects of transportation and transportation planning; (2) priorities for road construction; (3) preservation of the environment; (4) specific objections about roads and (5) specific suggestions for improved transportation.

Table 5 gives a summary of the results as obtained from the survey. Questions which ask for an opinion as to relative importance of an item used the following scale:



The results of the above goals and objectives survey together with the input from two public forums were the basis from which the Recommended Plan (Alternate Plan D) was developed.

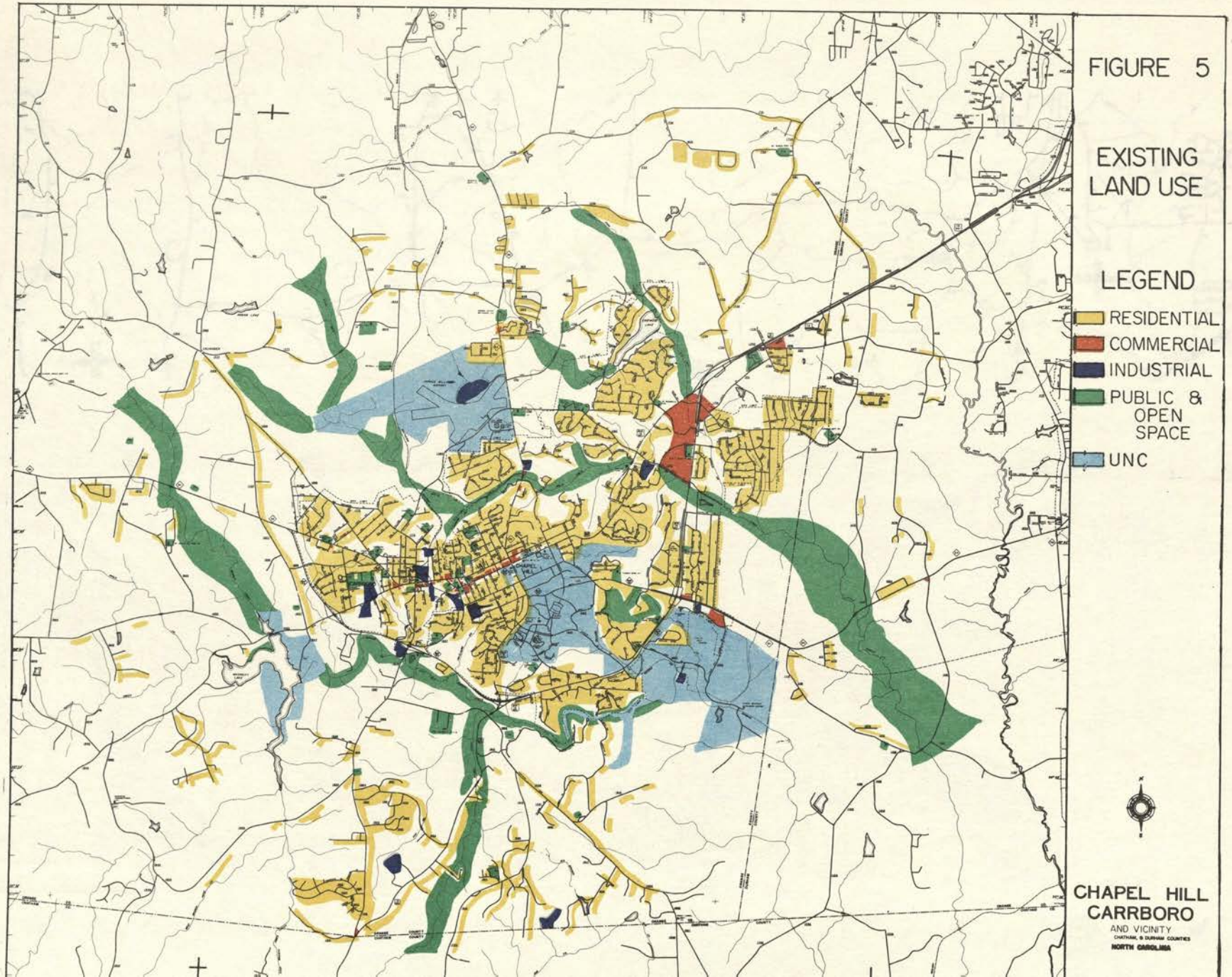


FIGURE 5
EXISTING LAND USE
LEGEND
RESIDENTIAL
COMMERCIAL
INDUSTRIAL
PUBLIC & OPEN SPACE
UNC
CHAPEL HILL
CARRBORO
AND VICINITY
CHATHAM, & DURHAM COUNTIES
NORTH CAROLINA

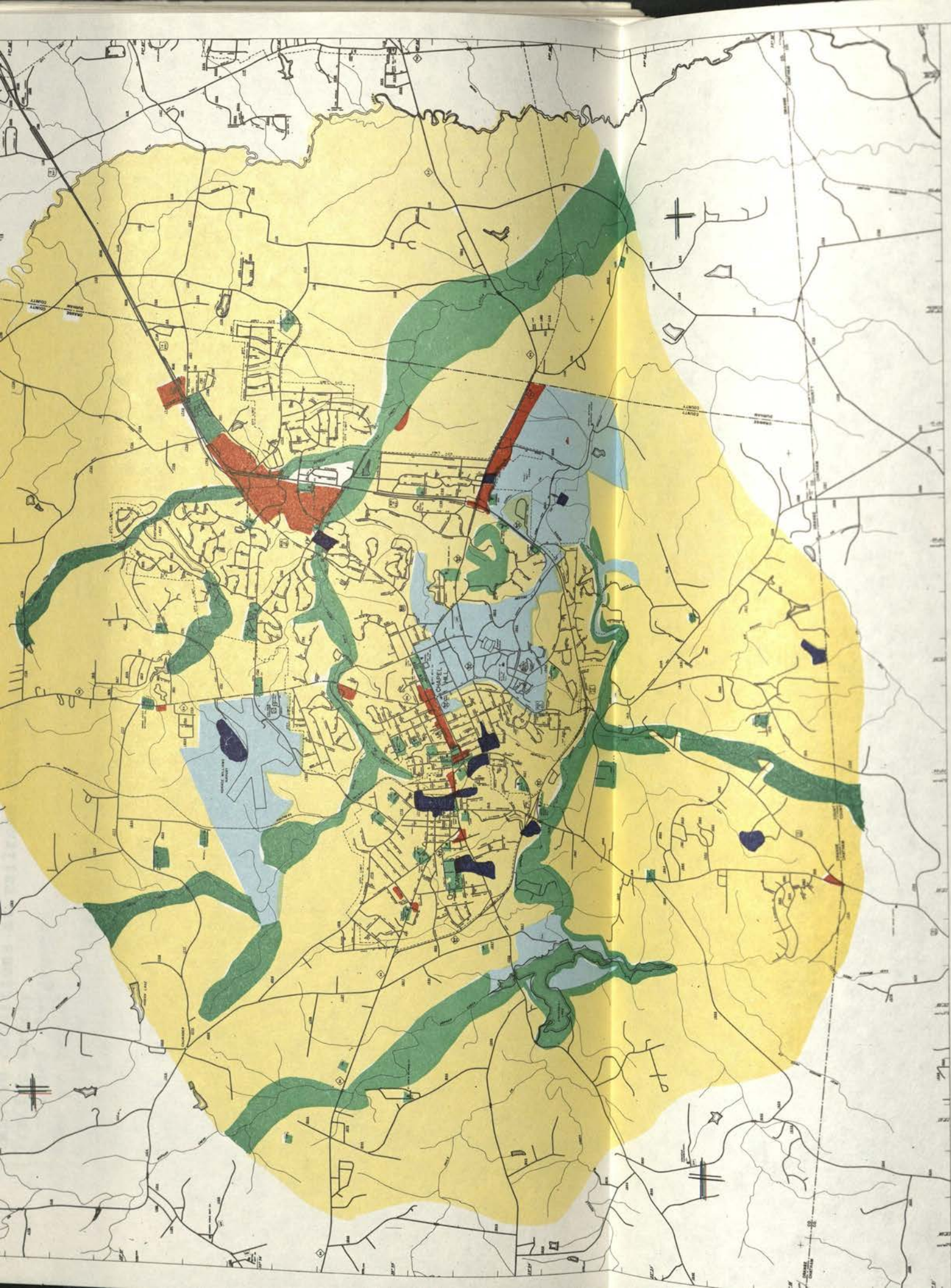


FIGURE 6

FUTURE LAND USE

LEGEND

RESIDENTIAL
COMMERCIAL
INDUSTRIAL
PUBLIC & O
SPACE
UNC

CHAPEL HI
CARRBOR
AND VICINITY
ORANGE, CHATHAM, & DURHAM COUN
NORTH CAROLINA
NORTH CAROLINA STATE HIGHWAY COMM
PLANNING AND RESEARCH DEPARTM
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

MARCH 1971

TABLE 5

Results of the Chapel Hill-Carrboro Goals and Objectives Survey
Question: Please indicate how important the following items are to you.

ITEM	AVERAGE RESPONSE	RANK
Trees and shrubs along streets	1.960	1
Land use zoning	1.925	2
Limit number of commercial signs along roads	1.920	3
Attractive roads and bridges	1.877	4
Sidewalks	1.825	5
Improve conditions at railroad crossings	1.820	6
Traffic safety	1.768	7
Parks and playgrounds	1.758	8
Cost of travel	1.706	9
Preservation of historic buildings	1.694	10
School travel	1.624	11
Air pollution caused by vehicles	1.620	12
Off-street loading areas for trucks	1.588	13
Neighborhoods	1.544	14
Home to work travel	1.524	15
Bicycle routes	1.514	16
City control over subdivision of land	1.509	17
Improved traffic flow at intersections	1.414	18
Access to homes	1.389	19
Restrict access along major thoroughfares	1.389	20
Noise caused by vehicles	1.385	21
Bicycle travel	1.369	22
Construction cost of transportation system	1.342	23
Access to central business area	1.309	24
Urban renewal	1.252	25
Bus transit	1.155	26
Scenic travelways	1.114	27
Special routes for trucks	1.105	28
Access to industry and shopping centers	1.019	29
Travel time	.961	30
Improve transportation system to attract industry	.599	31
One-way streets	.455	32
Taxi service	.259	33
Long, narrow strips of commercial development along thoroughfares	- .110	34

Vehicle Ownership Trends

Since 1945, the number of registered vehicles in the United States has tripled, and in North Carolina the total number of registered automobiles and trucks increased from 596,000 in 1945 to 3,129,564 in 1972, an increase of approximately 400 percent. During the same period, vehicle registration in Orange County increased by approximately 700 percent.

Vehicle registration has increased at a much greater rate than has population. The increase in vehicle registration as compared to the increase in population can be best shown by a graph depicting the change in persons per vehicle ratio over time. This ratio is obtained by dividing the total population of the area by the total number of vehicles registered in the area. Figure 7 shows this comparison for both the County and State with projections to 1995.

Travel Patterns

1971 Travel Desires

The essence of the derived thoroughfare plan is the ability to predict future traffic desires in response to land development demands. Therefore, a model must be developed to predict future demands. The model is postulated and calibrated using base year (1971) land use and traffic patterns as determined from an external origin - destination survey. This calibrated model is then used with projected land use data to generate future traffic desires.

An external cordon origin-destination traffic study for the Chapel Hill-Carrboro Planning Area was conducted by the Planning and Research Department[3], State Highway Commission[4], during the Spring of 1971. The complete data and detailed procedures used in obtaining the data are contained in the report External Origin and Destination Traffic Survey, Chapel Hill, North Carolina, prepared for the North Carolina State Highway Commission, 1971. This survey was conducted to ascertain through (station-to-station) and external (station-to-zone) trip movements,

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[3]The Planning and Research Department has been renamed The Planning and Research Branch.

[4]The State Highway Commission has been renamed the Department of Transportation.

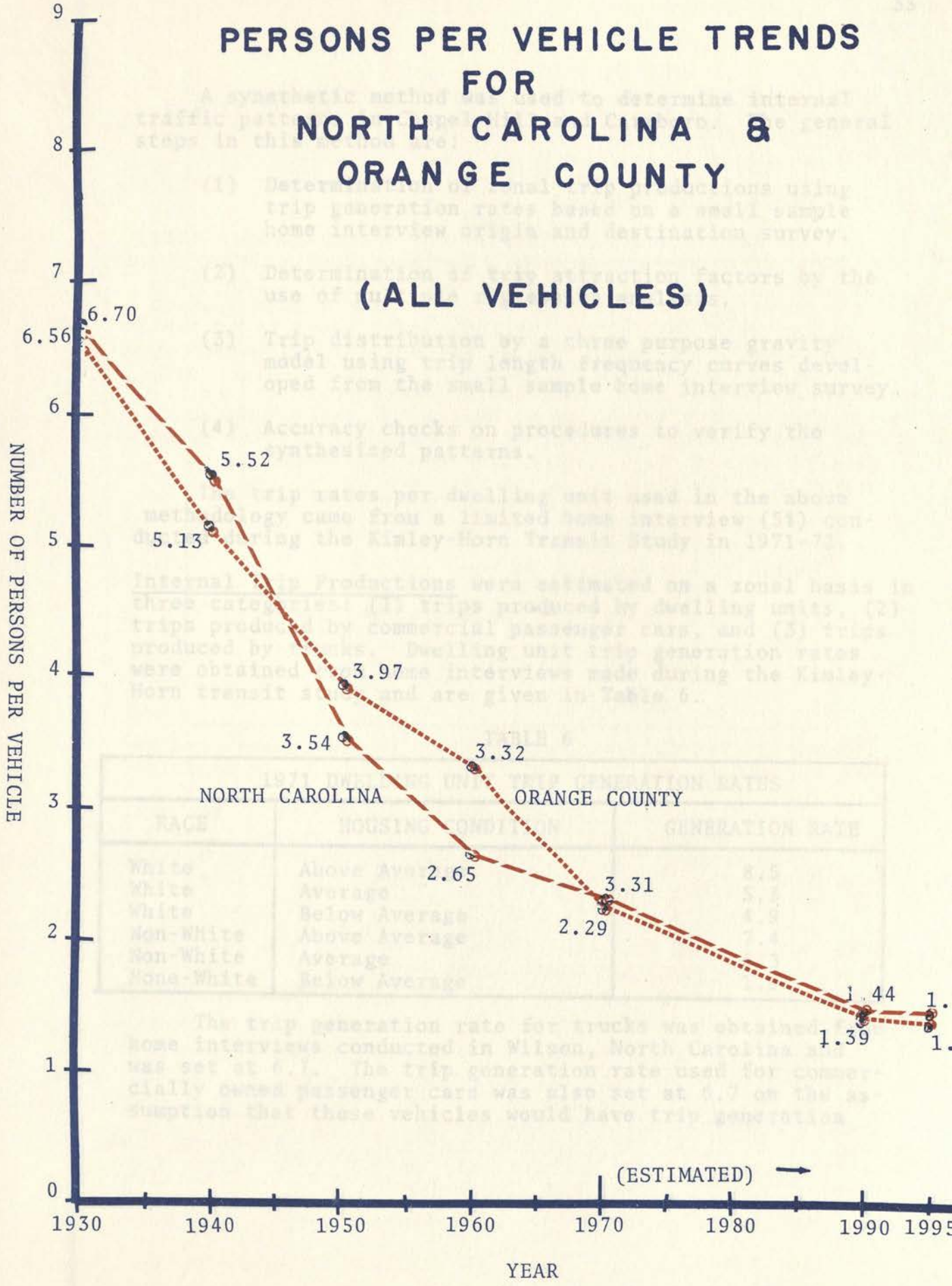
PERSONS PER VEHICLE TRENDS
FOR
NORTH CAROLINA &
ORANGE COUNTY
(ALL VEHICLES)
NUMBER OF PERSONS PER VEHICLE
YEAR
NORTH CAROLINA
ORANGE COUNTY
(ESTIMATED)
6.70
6.56
5.52
5.13
3.97
3.54
3.32
2.65
3.31
2.29
1.44
1.39
0
1
2
3
4
5
6
7
8
9
1930
1940
1950
1960
1970
1980
1990
1995

FIGURE 7

A synethetic method was used to determine internal traffic patterns in Chapel Hill and Carrboro. The general steps in this method are:

(1) Determination of zonal trip productions using trip generation rates based on a small sample home interview origin and destination survey.

(2) Determination of trip attraction factors by the use of multiple regression analysis.

(3) Trip distribution by a three purpose gravity model using trip length frequency curves developed from the small sample home interview survey.

(4) Accuracy checks on procedures to verify the synthesized patterns.

The trip rates per dwelling unit used in the above methodology came from a limited home interview (5%) conducted during the Kimley-Horn Transit Study in 1971-72.

Internal Trip Productions were estimated on a zonal basis in three categories: (1) trips produced by dwelling units, (2) trips produced by commercial passenger cars, and (3) trips produced by trucks. Dwelling unit trip generation rates were obtained from home interviews made during the Kimley-Horn transit study and are given in Table 6.

TABLE 6

1971 DWELLING UNIT TRIP GENERATION RATES		
RACE	HOUSING CONDITION	GENERATION RATE
White	Above Average	8.5
White	Average	5.3
White	Below Average	4.9
Non-White	Above Average	7.4
Non-White	Average	6.3
None-White	Below Average	1.9

The trip generation rate for trucks was obtained from home interviews conducted in Wilson, North Carolina and was set at 6.7. The trip generation rate used for commercially owned passenger cars was also set at 6.7 on the assumption that these vehicles would have trip generation

characteristics similar to trucks. The trip generation rate for taxis was estimated to be 40 trips per vehicles per day.

Internal Trip Attractions

The trip attraction factors for home base work (HBW) trips were assumed to be total employment by zone as given in Table 4 (Page 25). Trip attraction factors for other trip purposes were assumed to be the same within a given zone and were determined for individual zones by multiple regression techniques based on the origin-destination survey data. The external trip ends for all vehicles were used as the dependent variable and were regressed on by six independent variables to derive the estimating model. The final equation did not utilize all six initial independent variables, although all were considered in the analysis. The final equation used was as follows:

$$Y = 33.35 + 2.74X_1 + 9.54X_2 + 0.28X_3$$

Where Y = Attraction Factor

X_1 = Retail and Wholesale Employment

X_2 = Highway Retail Employment

X_3 = Dwelling Units

The attraction factors computed by the model developed in the regression analysis are given in Table 1, Appendix B.

In testing the significance of the equation, the multiple correlation coefficient (R) was calculated to be 0.96. This is a measure of the association or dependence between the independent variables and the dependent variable. A value near 1.0 indicates a high degree of association. The T values of the regression coefficients were also significant which indicates that there was very little chance of the true value of any coefficient equaling zero. Multiple regression statistical data are given in Appendix A, Table 3.

Internal Trip Distribution - The gravity model trip distribution program was used to distribute internal trips. Input to this program included: (1) zone-to-zone travel times obtained from a traffic trees computer program utilizing the existing 1971 major street network; (2) individual zonal trip productions and attractions; and (3) trip length frequency curves for various categories.

The trip length frequency curves used were those derived in the Thomasville, North Carolina internal O-D survey since the maximum trip lengths were similar to those found in Chapel Hill-Carrboro. The trip distribution curves used are given in tabular form in Table 7.

TABLE 7

INTERNAL TRIP DISTRIBUTION FACTORS			
Travel Time Min.	Percent Trips Distributed		
	Home Based Work Trips	Other Home Based Trips	Non-Home Based Trips
1.0	0.00	0.00	0.00
2.0	0.63	1.44	3.15
3.0	7.58	8.28	9.45
4.0	16.18	21.55	27.15
5.0	20.10	19.25	20.85
6.0	23.19	16.75	15.52
7.0	15.54	11.98	10.18
8.0	6.30	9.19	7.39
9.0	5.59	5.76	3.39
10.0	2.60	3.76	1.45
11.0	1.15	1.29	1.09
12.0	0.72	0.15	0.24
13.0	0.42	0.15	0.12
14.0	0.00	0.45	0.02

The 1971 trip summary derived from this distribution is given in Appendix B, Table 1.

External and Through Trips - To inventory external and through trips, origin - destination (OD) traffic survey stations were established on a cordon line surrounding the survey area at each of the fifteen principle highways radiating out from the urban area.

Data obtained from the external survey indicated that 50,550 vehicles entered or left the study area during an average 24-hour period in May, 1971 with 6,558 of this total passing completely through the study area.

The external trips (50,550 - 6,558 = 43,992) were distributed to internal zones through the use of the gravity model distribution program with input as follows: (1) actual trip productions at external stations, (2) attraction factors produced by multiple regression analysis, (3) trip length frequency curve as determined by the external survey, and (4) station-to-zone travel times. By using

the gravity model to predict and distribute existing trips, a base is established for predicting and distributing 1995 external trips. The tabulation for 1971 external trip totals resulting from the gravity model distribution program are given in Appendix B, Table 3.

The through trip movements are obtained directly from the external traffic survey and the totals are shown in Appendix B, Table 3.

Accuracy Checks on Procedures - The synthetic method of developing internal travel patterns was checked by assigning internal, external, and through trips to the existing major street network and comparing these volumes with those taken during the origin-destination survey. The assignment was made on the major street network by a computer traffic assignment program on a minimum travel time basis.

The actual traffic volumes compared to the assigned volumes from the gravity model distribution, as shown in Table 8, indicated that the assigned volumes represented 92.1 percent of actual volumes on Screenline A and 95.0 percent on Screenline B.

TABLE 8

COMPARISON OF ASSIGNED AND ACTUAL SCREENLINE CROSSINGS

Screenline	1971 Traffic Volumes		Percent Accuracy
	Actual Crossing	Assigned Crossing	
A	42,760	39,378	92.1
B	46,830	44,474	95.0

A summary of the comparison of assigned traffic to existing ground counts is given in Table 9. The results of this comparison were felt to be within acceptable limits for the purpose of this study.

TABLE 9

COMPARISON OF ASSIGNED TRAFFIC TO 1971 GROUND COUNTS

Volume Group	Number of Observations	Average Ground Count	Average Assigned Volume	Average Percent Difference
0000-1000	10	647	621	13.8
1001-3000	18	2299	2044	10.9
3001-5000	12	4005	3978	36.0
5001-10,000	27	7595	6843	17.5
10,001 & Over	24	14,136	13,190	11.0

1990 and 1995 Travel Desires

Internal Trips - Internal travel patterns for 1990 and 1995 were estimated based on 1990 and 1995 planning area data and follows the same procedures used in estimating the 1971 travel patterns.

The 1990 dwelling unit trip generation rates were calculated by multiplying a composite factor of 1.58 by the 1971 dwelling unit generation rate. The composite factor of 1.58 was obtained by multiplying the estimated vehicle ownership increase factor of 1.60 by an estimated vehicle usage decrease factor of 0.99. The 1990 dwelling unit generation rates classified by race and housing condition are shown in Table 10. The 1990 dwelling unit generation rates were assumed to remain constant through 1995 and were used to calculate the 1995 dwelling unit trip data.

TABLE 10

1990 DWELLING UNIT TRIP GENERATION RATES

Race	Housing Condition	Generation Rate
White	Above Average	13.5
White	Average	8.4
White	Below Average	7.8
Nonwhite	Above Average	11.7
Nonwhite	Average	10.0
Nonwhite	Below Average	3.0

The 1990 and 1995 trip generation rates for trucks and commercial cars were assumed to remain constant throughout the planning period at 6.7 trips per vehicle.

The number of dwelling units expected to be in the planning area by 1995 was based on the land development plan, the estimated 1995 zonal population, and the estimated 1995 persons per dwelling unit average of 2.4. The 1990 dwelling units were estimated by applying the following factors:

$$\frac{\text{1990 population}}{\text{1995 population}} \times \text{1995 dwelling units} = 0.92 \times \text{1995 D. U.'S.}$$

The estimated 1990 and 1995 trips were calculated by multiplying the number of dwelling units in each zone by the appropriate generation rate.

The number of trucks, commercial passenger vehicles and taxis garaged in the planning area in 1995 was estimated as follows:

$$\text{1995 Trucks} = \frac{\text{1971 Trucks}}{\text{1971 Total Vehicles}} \times \text{1995 Total Vehicles}$$

$$\text{Total Vehicles} = \frac{\text{1995 Estimated Population}}{\text{Estimated Persons Per Vehicle}}$$

These vehicles were then distributed to individual traffic zones on the basis of the land development plan and anticipated commercial and land use trends. Truck, commercially owned passenger car, and taxi generation rates were expected to remain constant over the planning period.

The non-home based and other home based trip attraction factors were determined by input of 1990 and 1995 population and employment data into the multiple regression equations. Total 1990 and 1995 employment figures by zone were used as attraction factors for home based work trips.

Trip generation rates, trip production computations, and NHB and OHB trip attraction factors for 1995 are given in Appendix B, Table 2.

A three purpose gravity model distribution program was used to distribute both the 1990 and 1995 internal traffic. This was the same procedure used in distributing 1971 internal traffic. Travel times used in this program

were based on the 1995 thoroughfare system. The estimated 1995 internal trip table resulting from this procedure is shown in Appendix B, Table 2.

External and Through Trips - External and through trips for 1990 and 1995 were estimated based on historical trends. Projected volumes for these trips are shown in Table 11. The ratio of external trips to through trips is expected to remain constant throughout the planning period.

TABLE 11

PROJECTED EXTERNAL STATION TRAFFIC VOLUMES

STATION	STATION	1971 VOLUMES	1990 VOLUMES	1995 VOLUMES
NC 86 (N)	1	4,450	9,600	10,800
SR 1734	2	1,130	1,800	2,000
US 15-501 (NE)	3	20,200	34,500	38,500
SR 1127	4	1,100	1,700	1,900
NC 54(E)	5	7,000	14,000	15,800
SR 1109	6	400	800	900
SR 1008	7	1,920	3,100	3,400
SR 1915	8	220	350	400
US 15-501(S)	9	6,450	13,000	14,500
SR 1939	10	260	400	450
SR 1942	11	840	1,350	1,500
SR 1005	12	1,450	2,300	2,500
NC 54(W)	13	3,000	5,400	6,000
SR 1104	14	1,270	2,000	2,200
SR 1009	15	860	1,400	1,500

The gravity model was used to distribute 1990 and 1995 external traffic to internal zones. Input to the model included (1) external trips generated at the external stations, (2) attraction factors as estimated by the multiple regression equations, (3) trip length frequency curves as determined by the 1971 external traffic survey, and (4) 1995 travel times for station to zone movements. Totals for the estimated 1995 external trip table resulting from this distribution is shown in Appendix B, Table 3.

The estimated 1990 and 1995 through trip ends were balanced using the Fratar Trip Balancing Computer Program[5]. Totals for the estimated 1995 through trip movements are shown in Appendix B, Table 3.

Adjustment of Projected Travel for Transit Usage

In the opinion of the study staff, an update of the Chapel Hill - Carrboro transportation plan would have been incomplete without an attempt to model the impact of the recently implemented bus system (1974) on the travel characteristics and patterns for the planning area. This modeling procedure can be summarized by the following steps:

(1) Determination of those traffic analysis zones where trip generation (auto-driver productions and/or attractions) is greatly impacted by the transit system in question. Some of these zones included the University, Chapel Hill CBD, residential areas, and shopping centers, especially those which are participating in park-and-ride.

(2) Determination of a quantitative estimate of total transit ridership for design year (1995).

(3) Allocation of this estimate (mode split in terms of reduced auto driver productions and attractions) to those zones as determined in step 1.

(4) A redistribtuion of the revised auto-driver trips using the gravity model.

The above process was applied only to the internally produced trips by assuming that the bus system would have a negligible effect on the external and through traffic. Special consideration was given the bus impact assignment during the determination of lane requirements, especially on projects near the CBD. The bus system is discussed further in the transit section of this report and a special assignment depicting the reduced auto-driver trips is shown in Figure 12.

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[5] "Discussion of Fratar Procedures for Forecasting Interzonal Volumes" (a report by the Division of Highway Planning, Bureau of Public Roads, Washington, D. C. , undated).

IV. ANALYSIS OF EXISTING MAJOR STREET SYSTEM

An analysis of the existing major street system and present travel patterns is necessary to determine existing deficiencies and to anticipate future traffic requirements.

The existing major street system is characterized by a random arrangement of urban and suburban streets feeding into three primary highways -- US 15-501, NC 54, and NC 86. US 15-501 is a basically north-south route serving a radial function. NC 54 is a east-west route serving as a radial street. NC 86 is a north-south radial that coincides with Airport Road entering from the north.

NC 54 Bypass along with US 15-501 Bypass serves as a loop facility around the southern part of the CBD area.

The street pattern in the CBD, which partially surrounds the central campus of UNC, is basically a grid system.

Street widths in the Planning Area range from a 76-foot face-to-face of curb section of NC 54 to a narrow dirt road serving an area north of town. An inventory of the major streets in the study area is presented in Appendix A, Table 1.

Effect of Existing and Projected Travel Patterns

Average 24 hour traffic counts for May, 1971 are shown in Figure 8. The most traveled street in the Planning Area is Franklin with traffic volumes up to 15,000 vehicles per day in Chapel Hill. Columbia Street and Pittsboro Road are the major north-south arterials with volumes of 12,500 and 7,500 respectively. Traffic volumes on radial routes leading into Chapel Hill-Carrboro range from 10,000 to 12,000 on US 54 East, 15,000 to 20,000 on BUS 15-501 North and US 15-501 North, 4,000 to 8,000 on US 86 North, 6,000 to 9,500 on US 15-501 South, and 2,500 to 4,500 vehicles per day on US 54 West.

Projected 1995 travel patterns were assigned to the major street network to determine its future adequacy and to locate problem areas. The traffic assignment was made by an all-or-nothing, non-directional computer assignment program. This program assigns all of a specific traffic movement to the route with the shortest travel time. The 1995 assignment volumes are shown on Figure 8.

A comparison of the assigned 1995 volumes with the 1971 volumes indicated that traffic congestion will become intolerable long before 1995 if significant improvements are not made. The heaviest traveled routes were US 54 East, US 15-501 North, US 54 Bypass, US 15-501 Bypass, Columbia Street, Franklin Street, Cameron Avenue, Airport Road, Merritt Mill Road, SR 1005, and SR 1919.

Capacity

A relatively good indication of the adequacy of the existing street system is a comparison of traffic volumes with the ability of the streets to move traffic. In an urban area, a street's ability to move traffic is generally controlled by the spacing of major intersections, the width of the pavement, and the traffic control devices utilized. Thus, the ability of a street to move traffic can be increased to some degree by restricting parking and turning movements, using proper sign and signal devices, and by the application of other traffic engineering techniques. Capacity is defined as the maximum number of vehicles which has a reasonable expectation of passing over a given section of a roadway in one direction, or in both directions, during a given time period under prevailing roadway and traffic conditions.[6] The relationship of traffic volumes to the capacity of the roadway will determine the level of service being provided. Six levels of service have been selected to identify the conditions existing under various speed and volume conditions on any highway or street. The level of service usually suitable for urban design practice is level of service C and is defined as being in the zone of stable traffic flow with most drivers restricted in their freedom to select their own speed, change lanes or pass. A relatively satisfactory operating speed is attained at this level of service.[7]

On a street where traffic signals exist, the capacity of the street is usually controlled by the capacity of the approach to the signalized intersection. Due to the time-sharing nature of traffic signals, traffic on any one approach is allowed only to move during a percentage of the cycle time. The percentage will usually depend on relative

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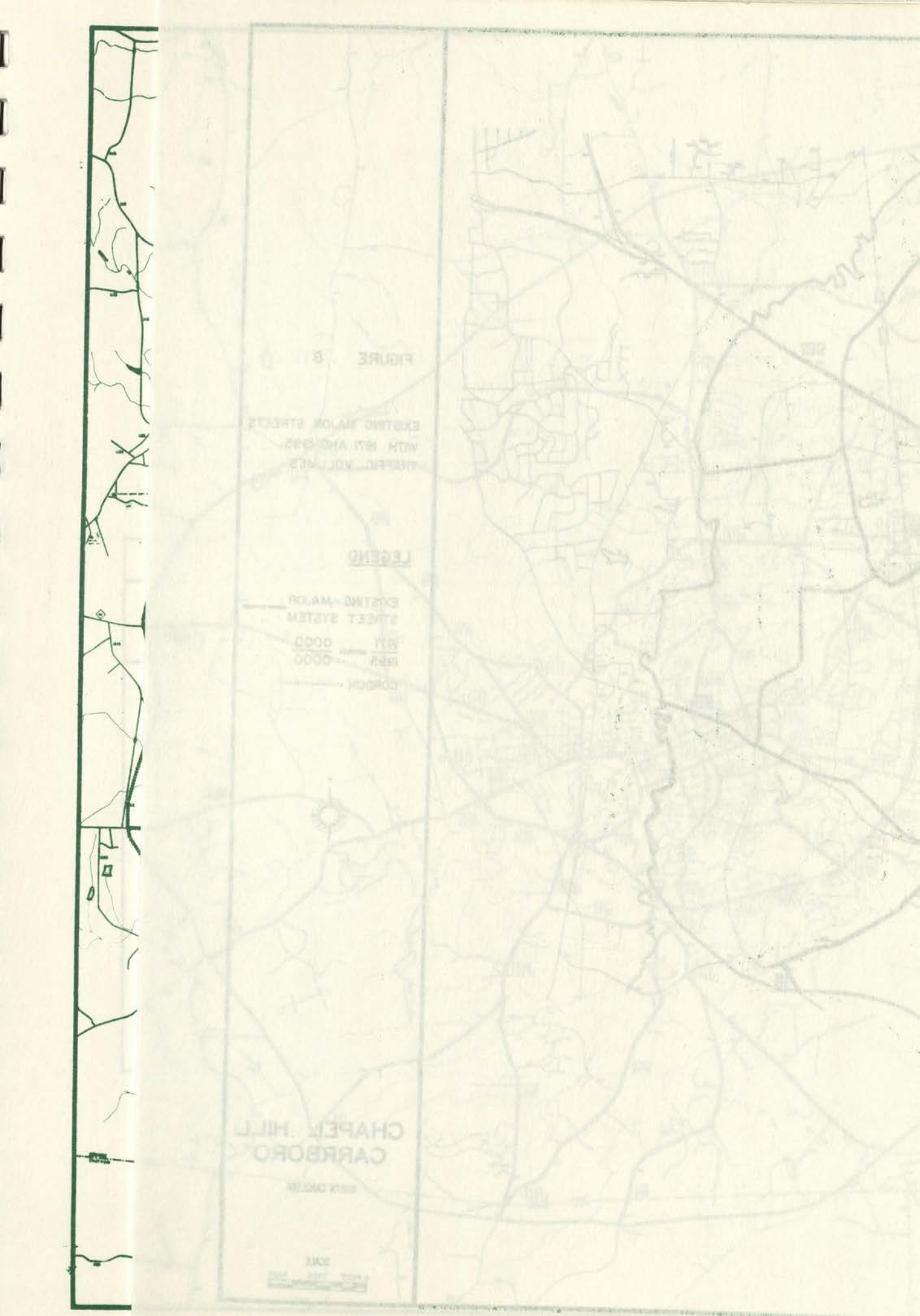
[6] Highway Capacity Manual, Highway Research Board Special Report, 87, 1965, p. 5.

[7] Ibid.



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1995 if significant improvements are not
traveled routes were US 54 East, US 15-
pass, US 15-501 Bypass, Columbia Street,
heron Avenue, Airport Road, Merritt Mill
SR 1919.

Capacity

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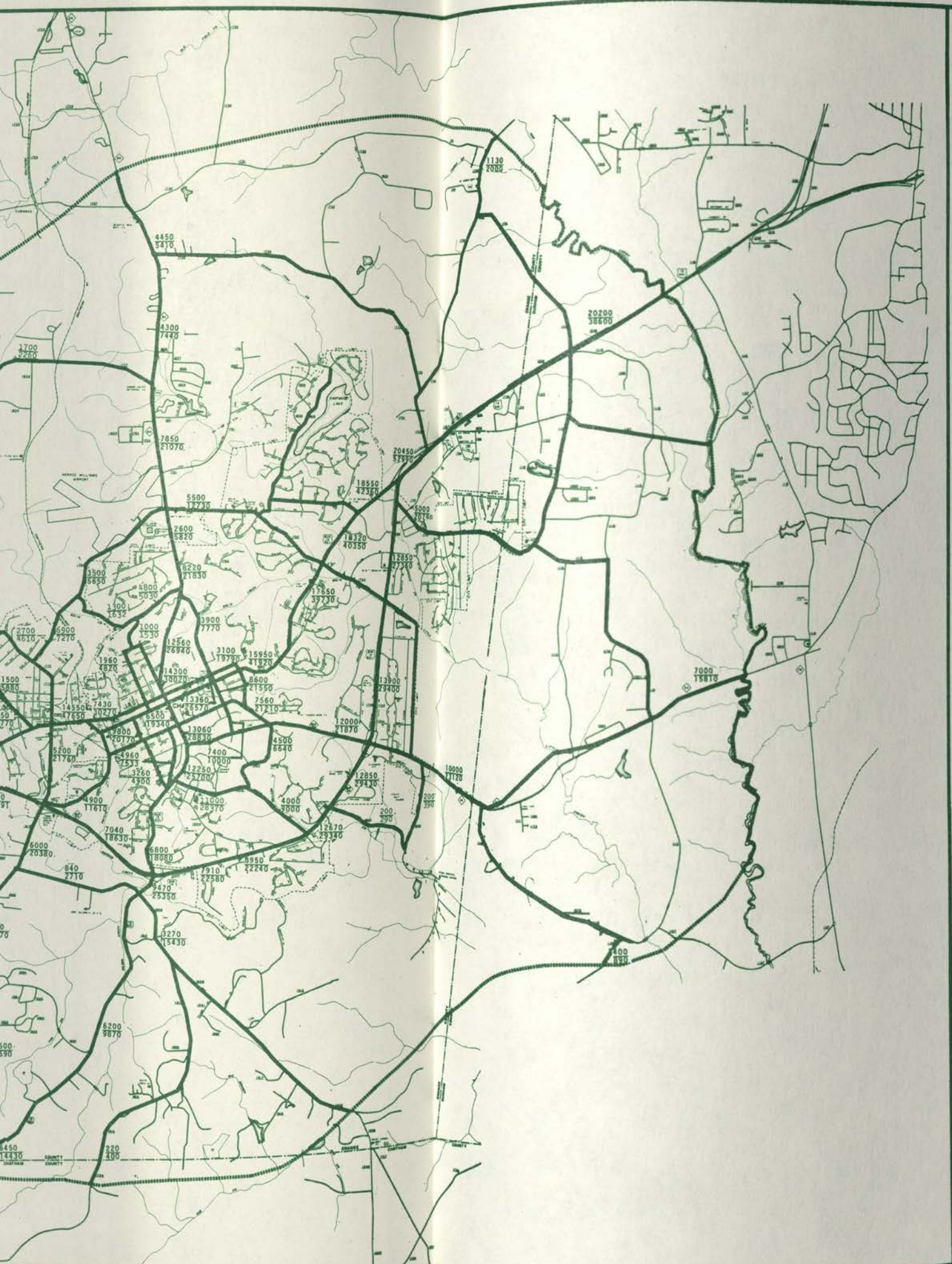


FIGURE 8

EXISTING MAJOR STREET
WITH 1971 AND 1995
TRAFFIC VOLUMES

LEGEND

EXISTING MAJOR STREET SYSTEM

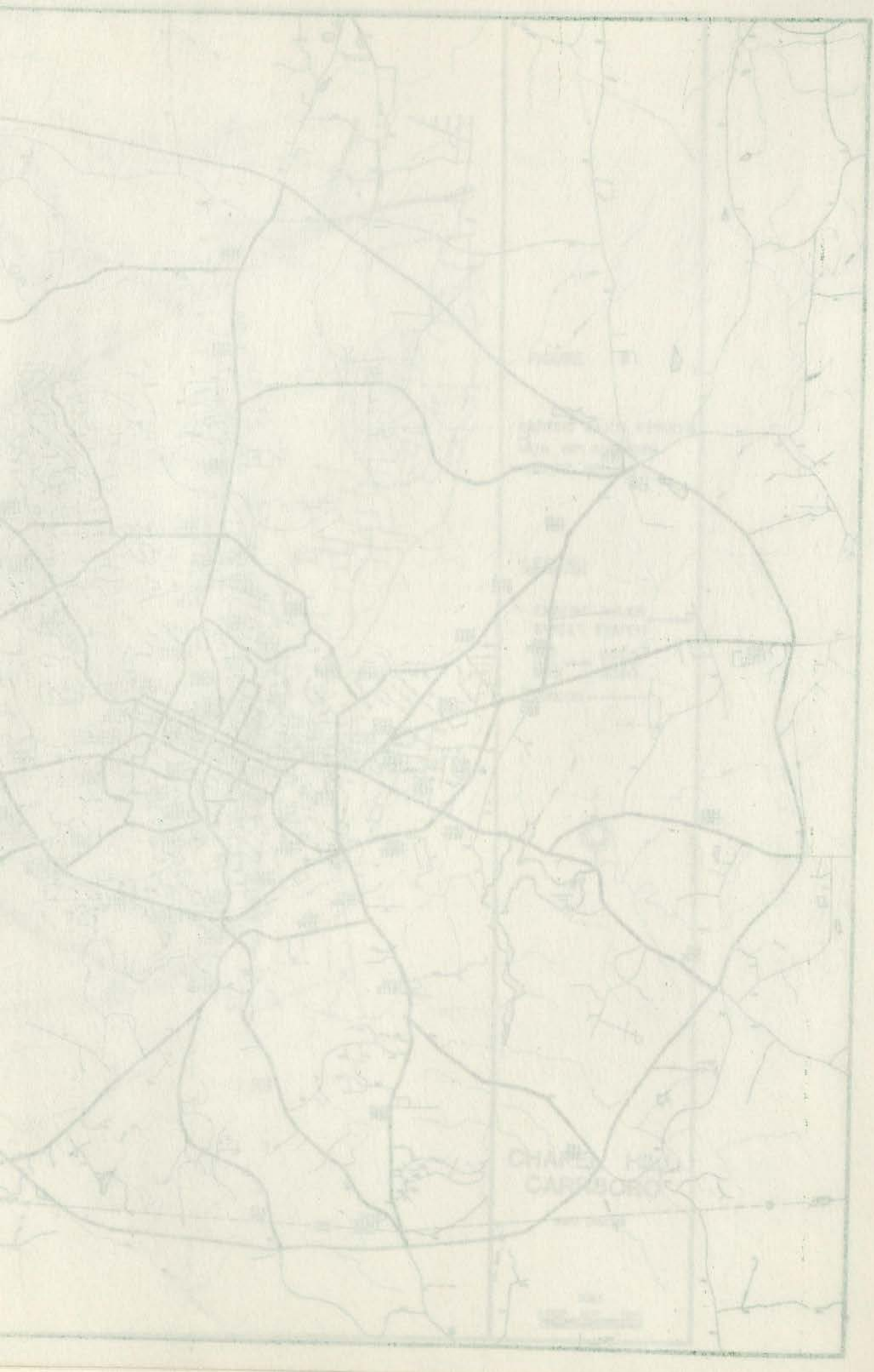
1971 / 1995 — 0000 / 0000

CORDON .....

CHAPEL HIL
CARRBORO

NORTH CAROLINA

SCALE
0 FEET 2000 4000



approach traffic demands and in most cases will fall within the range of from 30 to 70 percent of cycle length. Frequently, however, signals exist where "green time" is inequitably assigned. In cases like this street capacity could be increased and traffic operations improved merely by adjusting approach green time to correspond to respective approach demands.

Recently, a proposed upgrading of nineteen traffic signals in the Central Business District of Chapel Hill and Carrboro was implemented. The traffic signal improvements included the pulling of all new spans and guys, hanging new signal heads, installing new traffic controllers and detectors, and installing all new hardware as specified. Table 12 shows the location of the nineteen traffic improvements and the year that demand would cause a capacity deficiency.

TABLE 12

SIGNALIZED INTERSECTION CAPACITIES

INTERSECTION	YEAR OF CAPACITY DEFICIENCY
W. Franklin St. (NC 54) at Mallette St.	1971
S. Columbia St. (US 501) at Franklin St.	1969
E. Franklin St. (US 501) at Henderson St.	1974
E. Franklin St. (US 501) at Hillsboro St.	1969
W. Franklin St. (NC 54) at S. Graham St.	1984
Hillsboro St. (SR 1748) at E. Rosemary St.	1977
N. Columbia St. (NC 86) at Rosemary St.	1970
W. Cameron St. at S. Columbia St.	1969
S. Columbia St. at South Rd.	1971
S. Columbia St. at Manning Dr.	1980
Country Club Rd. at Raleigh Rd.	1982
Raleigh St. at South Rd. (NC 54)	1970
South Rd. (NC 54) at Memorial Stadium	1978
Cameron Ave. (SR 1740) at Raleigh St.	1968
E. Main St. (NC 54) at Rosemary St.	1969
E. Main St. (NC 54) at Weaver St.	1977
E. Main St. (NC 54) at S. Greensboro St.	1977
W. Main St. (NC 54) at W. Weaver St.	1982
Weaver St. and Greensboro St.	N/A[a]

[a]Not Available

Traffic Accidents

Traffic accident records are of invaluable assistance in defining problem areas and often pinpoint a deficiency or causal element, such as poor design, ineffective use, inadequate signing, inefficient parking, bad sight distance, or other reasons. Accident patterns developed from analysis of accident data often lead directly to remedial action which produces a noticeable reduction in the number of accidents.

A statewide study of high frequency accident locations in urban areas is conducted by the Division of Highways (NCDOT). Two criteria were previously established by the State to help identify intersections as hazardous and to qualify them for the Urban Safety Program - (1) an average of six accidents a year or more and (2) a minimum accident exposure ratio of 0.8 accidents for every million vehicles entering the intersection. A review of the 1974 statistics of High Accident Frequency Locations shows that the area does have several high frequency accident intersections. Appendix A, Table 2, is a listing of these locations.

Parking Inventory and Analysis

Parking is a necessary consideration in any thoroughfare planning study because it directly affects the capacity of individual facilities. On-street parking directly limits the capacity of a facility, while a deficiency of parking adds to the congestion of an area by increasing circulation and not allowing parkers to unload.

Since on-street parking controls the capacity of individual thoroughfares, and hence the network, parking removal is one of the first procedures applied in attempting to improve the capacity of a facility. Removal of parking is by far the least expensive improvement which can be made to increase the capacity of a street. Whenever removal of on-street parking is undertaken, off-street parking should be provided to replace that which has been removed unless there is a surplus of parking in the immediate area.

In determining whether a parking surplus or deficit existed in the Chapel Hill-Carrboro Urban Area, a parking inventory was made of each business area. Having measured the supply, a generalized calibration of the parking demand of 1971 was made to define current needs.

To determine parking demands for 1995, a separate analysis was made using the parking space factor (P) multiplied by the daily auto driven trip ends in the CBD. The parking zone factor is best stated by the formula:[8]

$$P = \frac{drsc}{oe}$$

Where P = Parking space factor
d = Daytime business area travel factor = .70
o = Occupancy per vehicle (for auto-driven trips = 1.0)
e = Coefficient of space used = .85 (assumed)
r = Ratio of peak to total daytime parkers = .1 (assumed)
s = Seasonal peaking factor
c = Location adjustment factor to reflect concentration of elements in area

Note: When data for all factors is not known, desirable level of service assumes s and c equal to 1.1; the tolerable level of service assumes s equal to 1.0 and c equal to 1.1; the minimum level of service assumes s and c equal to 1.0.

Substituting into the previous equation yields:

$$P = \frac{(.70)(.1)(1.1)(1.1)}{(1.0)(.85)} = .100 \text{ (Desirable Level)}$$

$$P = \frac{(.70)(.1)(1.0)(1.1)}{(1.0)(.85)} = .091 \text{ (Tolerable Level)}$$

$$P = \frac{(.70)(.1)(1.0)(1.0)}{(1.0)(.85)} = .082 \text{ (Minimum Level)}$$

There were a total of 32,290 auto trip ends into the Chapel Hill study area in 1971 and 44,828 for year 1995.

There were 6,144 auto trip ends into the Carrboro study area in 1971 and 13,924 projected trip ends for year 1995. Assuming the parking variables remain stable, Table 13 shows the comparisons of parking supply and demand made

---

[8] Parking in the City Center, Wilbur Smith and Associates, New Haven, Connecticut, 1965

on the study area if no additional parking is created over the existing supply.

TABLE 13

Parking Supply and Demand						
	1971			1995		
	Supply	Demand	Surplus / Deficit	Supply	Demand	Surplus / Deficit
CHAPEL HILL						
Desirable	4176	3229	+ 947	4176	4483	-307
Tolerable	4176	2938	+1238	4176	4079	+ 97
Minimum	4176	2648	+1528	4176	3676	+500
CARRBORO						
Desirable	891	614	+ 277	891	1392	-501
Tolerable	891	559	+ 332	891	1267	-376
Minimum	891	504	+ 387	891	1142	-251

Future parking areas should be placed generally in and around the retail core areas and the University as this is where the greatest parking demand occurs and the area where the least parking is available. Increased future traffic volumes will necessarily cause removal of on-street parking. The loss of these spaces must be adequately compensated for by off-street lots within a convenient walking distance of the retail, educational, and service areas.

It should be noted that current bus ridership in Chapel Hill has somewhat reduced the parking demand at certain locations, especially in and around the University. Further reduction in parking demand should occur in the central business districts if future expansion of the bus service incorporated Carrboro while maintaining operations at the present high level of service.

V. RECOMMENDATIONS

Factors Affecting Thoroughfare Location and Design

The basic concept of an idealized thoroughfare system has been outlined in Chapter II. Many factors influence the final location, design, and ultimate designation of streets in a thoroughfare system. Certainly one of the most important factors taken under consideration is the anticipated future traffic demand. In addition to this factor, others which influence the final design are:

(1) The location of existing and anticipated major traffic generators such as shopping centers, central business areas, and, in Chapel Hill's case, the location of the University of North Carolina.

(2) Existing residential patterns, schools, churches and cemeteries.

(3) Topography

(4) The location and design of existing highways and streets.

(5) The level of service standards to be maintained on the urban street and highway system.

(6) Existing right-of-way and development adjacent to the present street system.

(7) Anticipated future land use. (This is important as the thoroughfare system will exert a major influence on future land development.)

(8) The anticipated availability of funds in establishing priorities for future improvements.

(9) The environmental impact of the thoroughfare system and its related highway construction on the surrounding area.

All these factors and other minor influences must be taken into consideration before final location or design of a thoroughfare can be resolved. It is readily apparent that the proposed thoroughfare plan is a logical compromise of the idealized with the practical.

Proposed Thoroughfare Plan

Based on analyses of existing and projected traffic and land use data, the major problems that needed to be resolved in the development of the proposed Chapel Hill-Carrboro thoroughfare system were:

(1) The existing and projected capacity problems on Rosemary Street, Greensboro Street, Main Street, and US 15-501 Business.

(2) Congestion in the CBD.

(3) Capacity problem on Bypass 15-501.

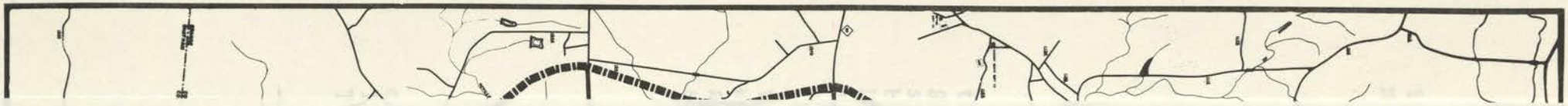
(4) Lateral circulation between outlying residential areas.

(5) Insufficient capacity along the major radials to adequately handle anticipated volumes of traffic.

Some of the elements of an idealized thoroughfare plan are not present in Chapel Hill and Carrboro as is true with many other North Carolina Cities and Towns. This is due in part to the lack of planning during the early stages of urban development coupled with a very rapid increase of public dependency on the motor car as a means of transportation. Missing or not well defined idealized thoroughfare elements must be compensated for by a judicious use of the present system and by what is reasonably possible to construct. The proposed Chapel Hill-Carrboro Thoroughfare Plan evolved by evaluating all previously listed factors which contribute to or have an effect upon the thoroughfare planning process along with special considerations for recent bicycling and bus transit impacts and it is graphically shown in Figure 9. This plan can best be described as follows:

Major Thoroughfares

The Radial Thoroughfares provide for the movement of traffic from points in the outlying and intermediate areas to the central area. Chapel Hill-Carrboro's radial system provides adequate access to the central area and



Proposed Thoroughfare Plan

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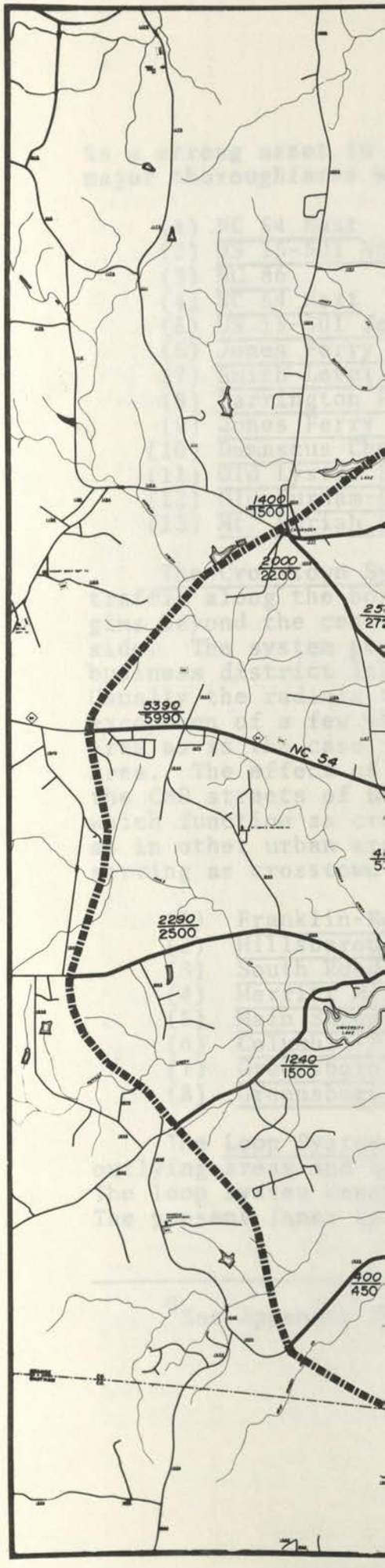
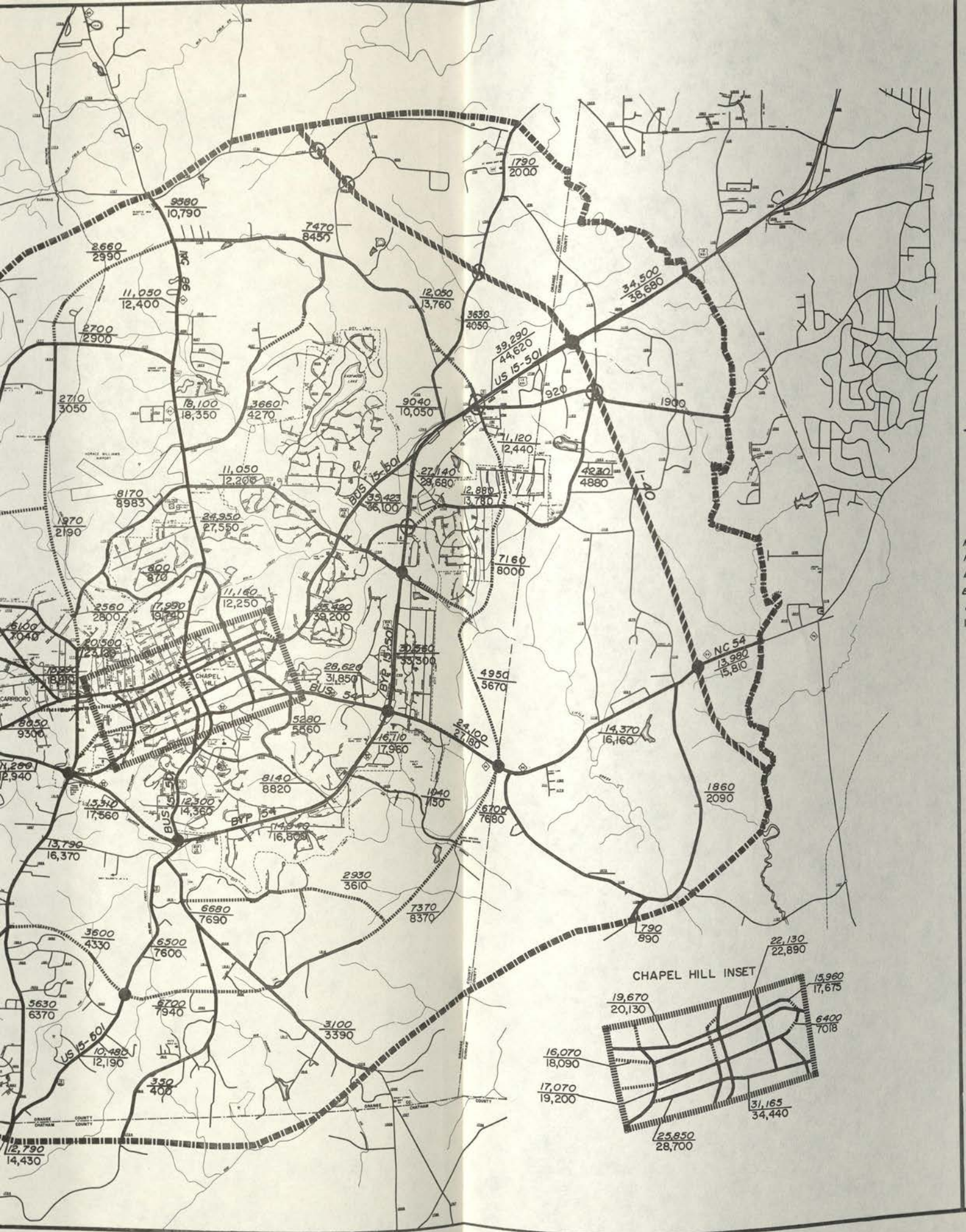




Recommended
Thoroughfare Plan "D"

LEGEND

	Exist.	Prop.
Major Thoroughfare		
Minor Thoroughfare		
Interstate		
External Cordon		
1990 Volumes		000
1995 Volumes		000

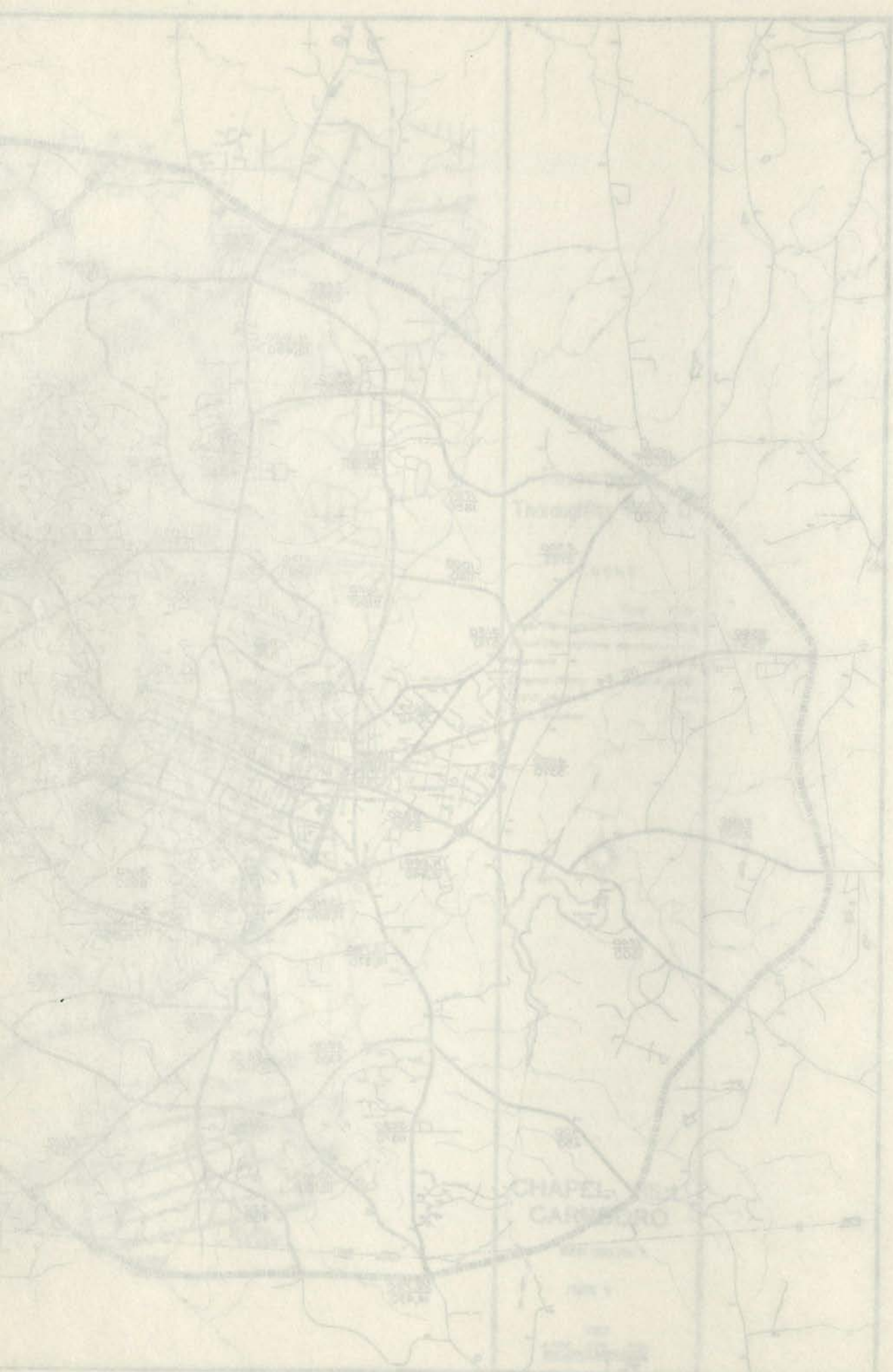
CHAPEL HILL
CARRBORO

NORTH CAROLINA

FIGURE 9

SCALE

0 FEET 2000 4000



is a strong asset in the overall thoroughfare plan. The major thoroughfares which serve as radial routes are:

(1) NC 54 East
(2) US 15-501 North
(3) NC 86
(4) NC 54 West
(5) US 15-501 South
(6) Jones Ferry Road (SR 1005)
(7) Smith Level Road (SR 1919)
(8) Farrington Road (SR 1008)
(9) Jones Ferry Road (beyond University Lake) (SR 1942)
(10) Damascus Church Road (SR 1939)
(11) Old Lystra Road (SR 1915)
(12) Old Durham-Chapel Hill Road (SR 1127)
(13) Mt. Moriah Church Road (SR 1734)

The Crosstown System of the thoroughfares ideally carries traffic along the borders of the CBD as it moves from origins beyond the central area to destinations on the other side. The system permits traffic to disperse around the business district instead of converging at any one point. Usually the radials terminate at the crosstown system with exception of a few which may enter and cross the central area as is the case in the Chapel Hill-Carrboro planning area. The effect of the crosstown system is to relieve the CBD streets of unnecessary traffic. The facilities which function as crosstowns are not so clearly defined as in other urban areas. However, the major thoroughfares serving as crosstown facilities are:

(1) Franklin-Rosemary one-way pair[9]
(2) Hillsborough Street
(3) South Road and McCauley Street
(4) Merritt Mill Road
(5) Main Street (Carrboro)
(6) Columbia-Pittsboro one-way pair[9]
(7) Greensboro Road
(8) Greensboro Street

The Loop System is intended to carry traffic between outlying areas and to provide for connectors between radials. The loop system consists of an Inner Loop and an Outer Loop. The present Inner Loop consists of:

---

[9]See Appendix for detailed analysis of one-way pairing

(1) Estes Drive on the north
(2) NC 54 Bypass on the west
(3) US 15-501 Bypass on the south and east

The proposed Outer Loop is primarily on new location around the urban area. The planning of this loop will enable developers and city officials to provide adequate right-of-way for construction of the loop when and if the need arises. Present volumes on the US 15-501 Bypass vividly point out the justification and function of an outer loop facility.

The Bypass System will consist of NC 54 Bypass, US 15-501 Bypass, and Interstate 40 (Proposed) in the northeast section of the planning area.

Minor Thoroughfares

Minor thoroughfares proposed for inclusion in the Chapel Hill-Carrboro Thoroughfare Plan are streets which serve a collector-distributor function and perform a greater land service function than the major thoroughfares. These streets are as follows:

(1) Main Street and Umstead Drive Connector (Proposed)
(2) Manning Drive
(3) Mason Farm Road

Design Requirements

Design requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each street section must be individually analyzed and its design requirements determined on the basis of projected traffic, existing capacity, desirable level of service and available right-of-way.

The level of service is a function of the ease of movement experienced by motorists using the facility. The ability of a motorist to drive at a desired speed is dependent upon the physical design of the street, the amount and character of traffic on the street, the spacing of intersections and use of traffic control devices, the influence and character of traffic generated by abutting property, and imposed speed restrictions.

There are many factors which influence the traffic capacity of a street (capacity being the number of vehicles that a street can accommodate). Some typical capacities for various street cross sections are related here for general guidance. Table 14 indicates typical capacities for various facilities in terms of vehicles per hour for a 24-hour period. These capacities are based on average traffic characteristics including 20 percent turning movements at principal intersections, 10 percent truck volumes, and approximately 50 percent green time at signalized intersections.

Typical cross section recommendations for Chapel Hill-Carrboro thoroughfares are shown in Figure 10. Cross section "A" is typical for controlled access facilities in rural areas. Cross sections "B" and "F" are typical for intermediate areas expected to be urbanized by the design year. Cross sections "C", "D", and "I" are typical for major thoroughfares in developed areas. Cross sections "E" and "H" are typical for minor thoroughfares. Cross section "G" would normally be used in rural areas or in staged construction.

Design year traffic movements were assigned to the thoroughfare plan to determine travel land requirements for thoroughfares included in the plan. This assignment is shown in Figure 9. Recommended typical cross sections for thoroughfares were derived on the basis of this traffic assignment, existing capacities, desirable levels of service, and available rights-of-way. The recommended typical cross sections for the Chapel Hill-Carrboro thoroughfares are given in Table 1, Appendix A.

On all existing and proposed major thoroughfares delineated on the Chapel Hill-Carrboro Thoroughfare Plan, it is recommended that adequate rights-of-way be protected or acquired for the ultimate cross sections. The "ultimate" desirable cross sections for thoroughfares are also listed in Table 1, Appendix A.

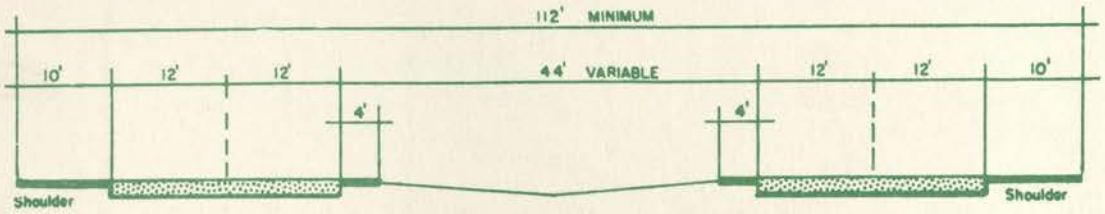
Construction Priorities and Cost Estimate

The recommended improvements are separated into projects and the projects grouped into four priority groups. The grouping by priority is an attempt to establish a suggested project schedule by designating which projects have the more urgent need and/or will serve a greater number of auto drivers, in relation to all improvements recommended by this plan. The project's priority groups may be thought of in time increments of approximately five years.

TABLE 14

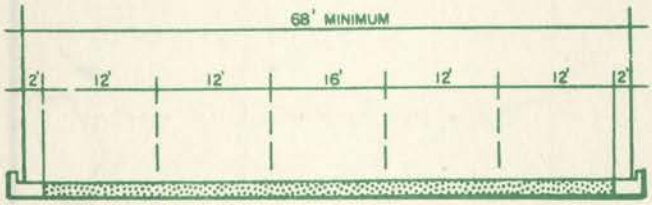
TYPICAL CAPACITY DESIGN STANDARDS

Facility	Practical Capacity	
	Vehicles Per Hour Per Lane	Vehicles Per Day
Two Lanes Plus Parking		
Two-way	400-500	5,700-8,200
One-way	450-600	10,000-13,000
Four Lanes, No Parking		
Two-way	450-550	13,000-18,500
Two-way with special measures	600-800	17,000-26,000
Four Lanes With Parking		
Two-way	350-450	10,000-15,000
Two-way with special measures	500-750	14,000-25,000
Six Lanes, No Parking		
Two-way with special measures	500-700	21,000-34,000
Four Lane Urban Expressway	800-1,000	23,000-33,000
Four Lane Urban Freeway	1,200-1,500	35,000-50,000
Six Lane Urban Freeway	1,200-1,500	50,000-75,000



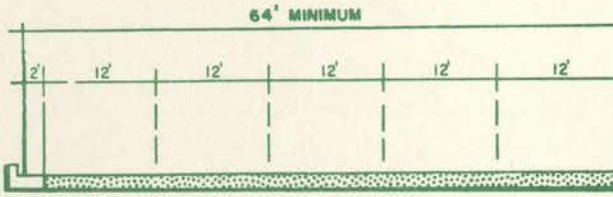
A

FOUR LANES DIVIDED WITH MEDIAN - RURAL



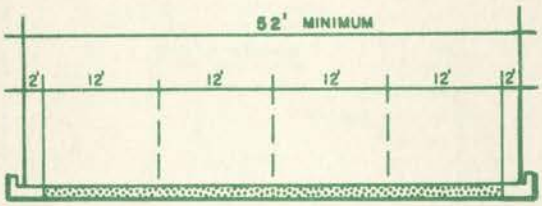
FIVE LANES - URBAN

B



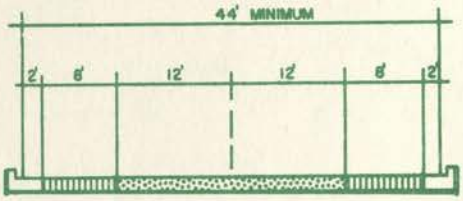
FIVE LANES - URBAN

C



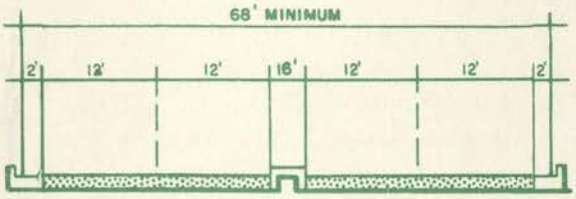
FOUR LANES - URBAN

D



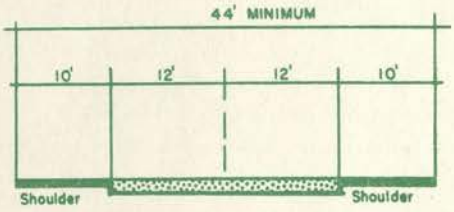
TWO LANES - URBAN
PARKING ON BOTH SIDES

E



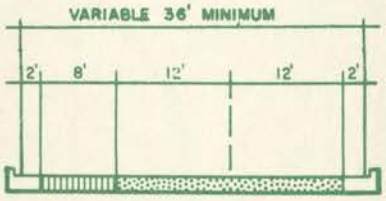
FOUR LANES DIVIDED WITH MEDIAN - URBAN

F



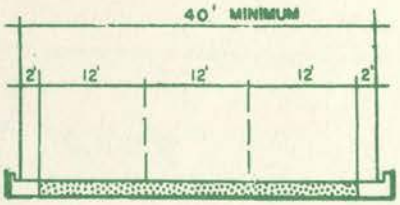
TWO LANES - RURAL

G



TWO LANES - URBAN
PARKING ONE SIDE

H

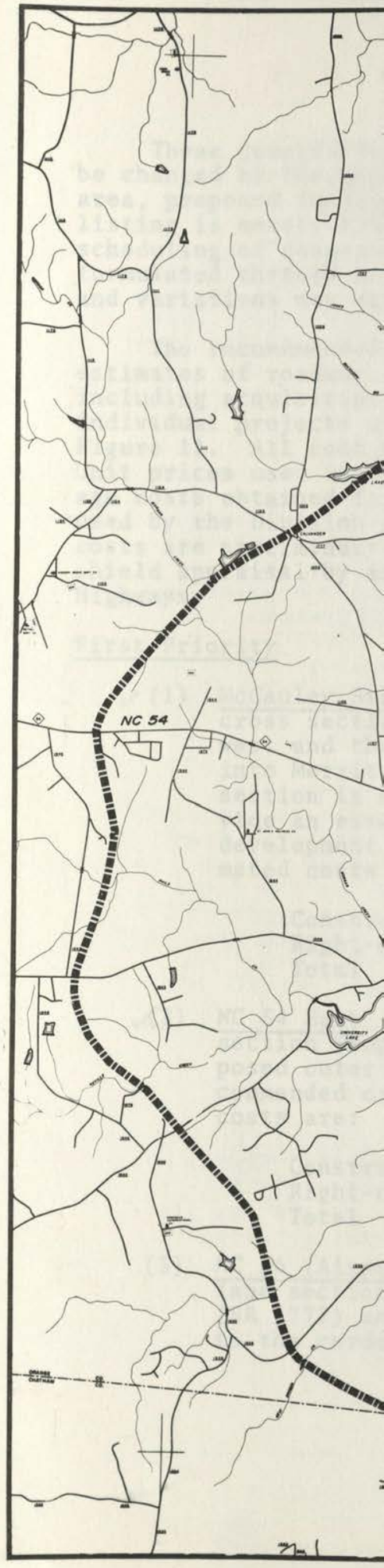


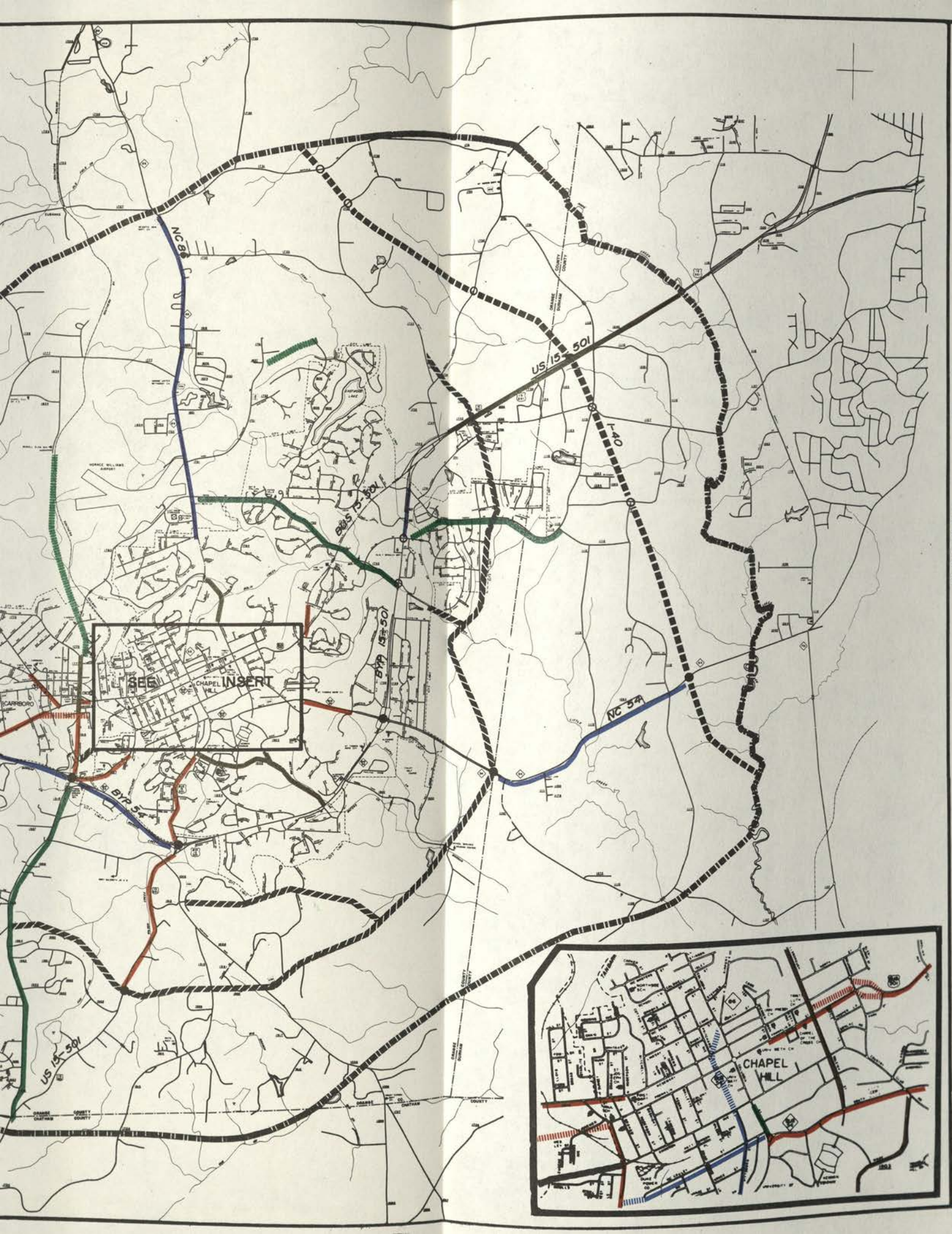
THREE LANES - URBAN

I

Typical Thoroughfare Cross Sections

FIGUR


NC 54



Construction Priorities
for
Recommended Plan "D

LEGEND

	Exist	Prop
1st Priority		
2nd Priority		
3rd Priority		
4th Priority		
Long Range		
At Grade Separation		○
Interchange		●

N

S

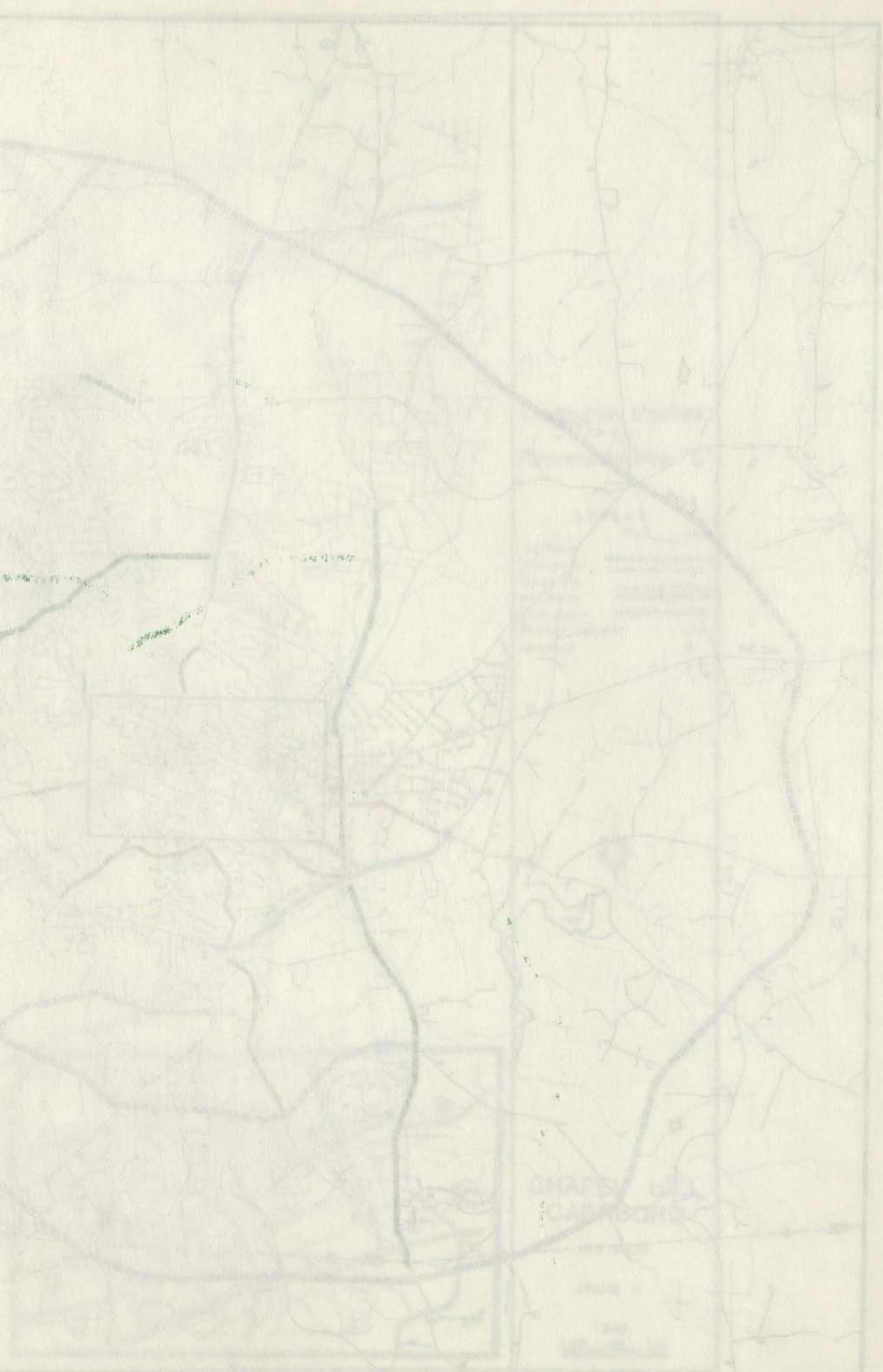
CHAPEL HILL
CARRBORO

NORTH CAROLINA

FIGURE II

SCALE

0 FEET 2000 4000



These construction priorities are not static and can be changed by the needs and desires of the people of the area, proposed funding, and engineering considerations. The listing is merely a convient method of judging the possible scheduling of construction. The following priorities were formulated through current transportation system analysis and variations may occur as a function of time.

The recommmended priority along with the preliminary estimates of roadway construction and right-of-way costs, including acquisition, utility, and relocation costs, for individual projects are listed below and are shown in Figure 11. All cost figures are in terms of 1974 dollars. Unit prices used in estimating construction costs are average costs obtained from bid sheets and unit price lists used by the Division of Highways, (NCDOT). Right-of-way costs are preliminary estimates determined from a windshield appraisal by an area appraiser of the Division of Highways.

First Priority

(1) McCauley Street - Widen to a four-lane urban cross section from Columbia to a point 0.55 mile west and then extend this section, tying it into Merritt Mill Road. The recommended cross section is D. The proposed extension will provide an essential new multilane element in the development of the crosstown system. The estimated costs are:

Construction	$284,000
Right-of-Way	0
Total	$284,000

(2) NC 54 East - Upgrading to a four-lane divided section from a point 0.1 mile east of the proposed outer loop to the cordon line. The recommended cross section is A. The estimated costs are:

Construction	$1,764,000
Right-of-Way	737,000
Total	$2,501,000

(3) NC 86 (Airport Road) - Widen to a five travel-lane section from Barclay Road to Homestead Road (SR 1777) and to a four-lane section from SR 1777 to the cordon line. The estimated costs are:

Construction	$1,205,000
Right-of-Way	72,000
Total	$1,277,000

(4) NC 54 Bypass - Development of a four-lane divided urban facility from a point 0.3 mile west of the US 15-501 interchange to Jones Ferry Road. This project provides an important element of the inner loop system. The estimated costs are:

Construction	$1,184,000
Right-of-Way	0
Total	$1,184,000

✓(5) US 15-501 Bypass - Develop a four-lane divided urban facility from SR 1814 to a point approximately 300 feet west of Winter Drive. This project provides an essential multilane element in the development of the inner loop system. The estimated costs are:

Construction	$2,646,000
Right-of-Way	0
Total	$2,646,000

✓(6) Pittsboro Street- Widen from Pittsboro Road to Cameron Avenue. Extend Pittsboro Street north to Pritchard Street. Construct connector from Pritchard Street to Columbia at North Street. This construction sets the stage for the Pittsboro-Columbia one-way pairs. The recommended cross section is I. The estimated costs are:

Construction	$ 321,000
Right-of-Way	3,618,000
Total	$3,939,000

Second Priority

(1) Rosemary Street - Widen from Henderson Street to 0.1 mile east of Boundary Street. This recommendation develops Rosemary Street for its one-way pairing with Franklin Street. Cross

section I is proposed. The estimated costs are:

Construction	$ 136,000
Right-of-Way	865,000
Total	$1,001,000

(2) Main Street - Cross section I is recommended from Rosemary Street to Greensboro Street. Cross section D is recommended from Jones Ferry Road to Hillsborough Road. The estimated costs are:

Construction	$ 274,000
Right-of-Way	844,000
Total	$1,118,000

(3) Franklin Street Extension - A westward extension of Franklin Street tying with Jones Ferry Road approximately 0.1 mile west of Bim Street completes the development of Franklin Street for its one-way pairing with Main and Rosemary Streets. The recommended cross sections will be I from existing Franklin Street to Greensboro Street with a two-lane urban section from Greensboro Street to the tie-in with Jones Ferry Road. The estimated costs are:

Construction	$ 356,000
Right-of-Way	2,300,000
Total	$2,656,000

(4) US 15-501 Business South - Widen to a four-lane urban section from the US 15-501 Bypass to Pittsboro Street. The proposed cross section is D. The estimated costs are:

Construction	$291,000
Right-of-Way	201,000
Total	$492,000

(5) US 15-501 Business North - Widen to five travel lanes with exclusive turn lanes at intersections from Park Place to Howell Lane. The estimated costs are:

Construction	$245,000
Right-of-Way	92,000
Total	$337,000

(6) Merritt Mill Road - Widen from Greensboro Street section is recommended. The estimated costs are:

Construction	$ 533,000
Right-of-Way	1,313,000
Total	$1,846,000

(7) Greensboro Street - Widen from NC 54 Bypass to Main Street. The recommended cross section is C. The estimated costs are:

Construction	$394,000
Right-of-Way	233,000
Total	$627,000

(8) Jones Ferry Road - Widen from the tie-in with the proposed Franklin Street Extension east to NC 54 Business. A two-lane urban cross section is recommended. This project completes the development of Rosemary and Main Streets and Jones Ferry Road for one-way pairing with Franklin Street. The estimated costs are:

Construction	$450,000
Right-of-Way	0
Total	$450,000

(9) US 15-501 South - Upgrade to a four-lane divided section from the cordon line to the US 15-501 Bypass interchange. The proposed cross section is A. The estimated costs are:

Construction	$2,205,000
Right-of-Way	326,000
Total	$2,531,000

(10) Park Place and Boundary Street Connector - Cross section H is proposed for this new facility. The estimated costs are:

Construction	$48,000
Right-of-Way	50,000
Total	$98,000

(11) South Road - Widen to a four-lane urban cross section with exclusive turn lanes from US 15-501 Business to Country Club Road and to a five-lane urban section from Country Club Road to Greenwood Road. The estimated costs are:

Construction	$687,000
Right-of-Way	0
Total	$687,000

(12) Rosemary Street and Franklin Street Connector - The proposed location is between the intersection at Hillsborough and Rosemary Streets and the intersection of Franklin Street and Park Place. The recommended cross section is I. The estimated costs are:

Construction	$ 53,000
Right-of-Way	140,000
Total	$193,000

Third Priority

(1) Estes Drive - Widen from NC 86 to US 15-501 Business. A four-lane urban cross section is recommended. The estimated costs are:

Construction	$656,000
Right-of-Way	201,000
Total	$857,000

(2) SR 1843 Extension - Construct a two-lane rural section connecting with SR 1772 at Pleasant Drive. The estimated costs are:

Construction	$748,000
Right-of-Way	103,000
Total	$851,000

(3) Smith Level Road (SR 1919) - Widen from US 15-501 to the proposed Outer Loop. The recommended cross section is G. Cross section D is recommended from the proposed Outer Loop to NC 54 Bypass. The estimated costs are:

Construction	$1,155,000
Right-of-Way	135,000
Total	$1,290,000

(4) Columbia Street - Widen to a three-lane cross section from McCauley Street north to Cameron Avenue. It is recommended that intersection improvements be made at Cameron Avenue which would permit better alignment of Columbia Street thereby increasing traffic carrying capabilities of this facility for its one-way pairing with Pittsboro Street. The estimated costs are:

Construction	$57,000
Right-of-Way	0
Total	$57,000

(5) Ephesus Church Road and Willow Drive Connector - The recommendation is a four-lane urban cross section located between the intersection of Nut Street and Willow Drive and the intersection of Ephesus Church Road and Bambury Lane. The estimated costs are:

Construction	$192,000
Right-of-Way	36,000
Total	$228,000

(6) Piney Mountain Road Extension (SR 1751) -Construct a two-lane urban section northward connecting with Kenmore Road. The estimated costs are:

Construction	$240,000
Right-of-Way	37,000
Total	$277,000

(7) Ephesus Church Road - Widen to a four-lane urban section from Bambury Lane to the intersection at SR 1113. The estimated costs are:

Construction	$315,000
Right-of-Way	244,000
Total	$559,000

Fourth Priority

(1) US 15-501 North - Upgrade to a four-lane urban freeway from the cordon line to the interchange at US 15-501 Business and US 15-501 Bypass. This facility will serve as the major radial route into the CBD. Projected volumes on some sections are greater than 50,000 ADT. The estimated costs are:

Construction	$675,000
Right-of-Way	0
Total	$675,000

(2) Old Greensboro Road - Widen to a four-lane urban section from Pleasant Drive to Main Street. The estimated costs are:

Construction	$209,000
Right-of-Way	139,000
Total	$348,000

(3) Manning Drive - Widen from US 15-501 Business to US 15-501 Bypass. Typical cross section E is proposed. The estimated costs are:

Construction	$544,000
Right-of-Way	0
Total	$544,000

(4) Ridge Road - Widen from South Road to Manning Drive to a two-lane urban section with parking on both sides. The estimated costs are:

Construction	$272,000
Right-of-Way	0
Total	$272,000

(5) Raleigh Street - Widen to a four-lane urban 40-foot face-to-face of curb section from South Road to Rosemary Street. The travel lane width is a function of a very restricted right-of-way situation in this area. The estimated costs are:

Construction	$136,000
Right-of-Way	0
Total	$136,000

(6) Hillsborough Street - Widen to a four-lane urban section from Rosemary Street to Airport Road. The estimated costs are:

Construction	$302,000
Right-of-Way	408,000
Total	$710,000

Total Construction	$18,577,000
Total Right-of-Way (Including Utilities)	12,285,000
Grand Total	$30,862,000

Long Range Planning

Ultimate desirable cross-sections for the Chapel Hill-Carrboro Thoroughfare System are listed in Table 1, Appendix A. Utilization of ultimate cross-sections, with few exceptions, will probably occur after the expiration of the planning period, 1995. Recommendations of ultimate cross sections are intended to provide some guidance for planning officials in situations where widening of curb and gutter may be desirable for reasons other than traffic service.

A constant reappraisal effort should be maintained in regard to the thoroughfare plan. There may develop situations where the priority of a certain project may need to be changed or the location of a certain route altered due to recent developments in the project vicinity.

It should be noted that other minor projects, which are not proposed as improvements in this thoroughfare plan, may be undertaken locally to improve the street system. There are several projects which are termed long range projects and may be added to the thoroughfare system as the need arises. These include:

(1) Cameron Avenue Extension from Merritt Mill Road to Greensboro Street.
(2) Construction of the Outer Loop as shown in Figure 11.
(3) Extension of Bayberry Drive to the Outer Loop.
(4) Extension of Estes Drive to the Outer Loop.
(5) Interchanges and Grade Separations along the Inner and Outer Loops.

These projects or others may be implemented to improve the efficiency and level of service of the transportation system whenever the urban area develops or expands.

Traffic Operations

Traffic operations is concerned with the efficient use of existing streets. Through the use of such techniques as one-way operations, coordination of traffic signals, provision of separate left turn lanes at intersections, intersection approach channelization, prohibition of on-street parking and other traffic controls, the ability of a street system to carry traffic can generally be significantly increased.

Intersections are quite frequently the critical areas in restricting the capacity of a thoroughfare. Due to conflicting traffic movements, they are also the areas with the highest accident rate. The type of control used at intersections depends on traffic and safety warrants, and may range from a simple stop sign at a minor intersection to a highly complex signal system at a major intersection.

Much of the efficiency of the recommended thoroughfare plan depends on the operational efficiency of the major intersections which is primarily dependent on the signal system efficiency and coordination. An improperly timed and poorly coordinated signal system can impede the flow of traffic and cause congestion on an otherwise adequate street.

The implementation of various elements in the thoroughfare plan will reduce congestion at problem intersections and deficient roadway sections. If nothing is done to implement the recommendations in this planning report, or possible modifications to these recommendations that arise in conjunction with the continuing planning process, then serious capacity deficiencies (intolerable congestion) will be the rule rather than the exception by the end of the planning period. Figure 8 emphasizes this point.

Mass Transit

In 1972, Kimley-Horn and Associates, Inc. performed the Technical and Feasibility Study of Public Mass Transportation Service for the Chapel Hill-Carrboro-UNC Urban Area. The study

was concerned with the physical and financial feasibility of a public transportation system in this area. A public transportation system was found to be in demand and within certain constraints, this system was found to be both physically and economically feasible. The results of the study, along with inventories, analyses, alternative concepts, and the recommended system are documented in the public transportation study report.

Portions of the recommended system were implemented in 1974. In order to reflect the impact of the implemented bus system on the update of the Chapel Hill-Carrboro Thoroughfare Plan, a ratio of the current ridership (person trips were converted to auto driver trips) to the total base year internal trips was obtained. With the assumption that this ratio could be maintained through year 1995, an additional computer assignment was made in an attempt to quantify the bus system's impact on the update of the Chapel Hill-Carrboro Thoroughfare Plan. The results of this assignment can be seen in Figure 12.

Bicycles and Bikeways in Transportation Planning

North Carolina's Bicycle and Bikeway Program

Any study or analysis of the transportation system for the Chapel Hill-Carrboro Planning Area would be incomplete without a consideration of bicycle traffic with its present and future impact on the thoroughfare planning process.

The reasons for this consideration are obvious. According to the Bicycle Institute of America, bicycle riding is increasing more rapidly than any other means of recreation or transportation in the United States. Factors contributing to this increase in bicycle usage are many. First, bicycling is economically sound. It consumes none of the precious fossil fuels and costs very little to maintain and operate. Second, it is sound environmentally because no pollution or noise is produced while the bicycle is in operation. Third, the bicycle has proven to be an exceptional means for physical fitness and mere enjoyment viewed respectively from a health and recreational standpoint. A last factor, but perhaps the most important, is that a cogent argument can be made for integrating the bicycle into and making it a viable part of the total transportation plan, especially in the light of recent fuel shortages.

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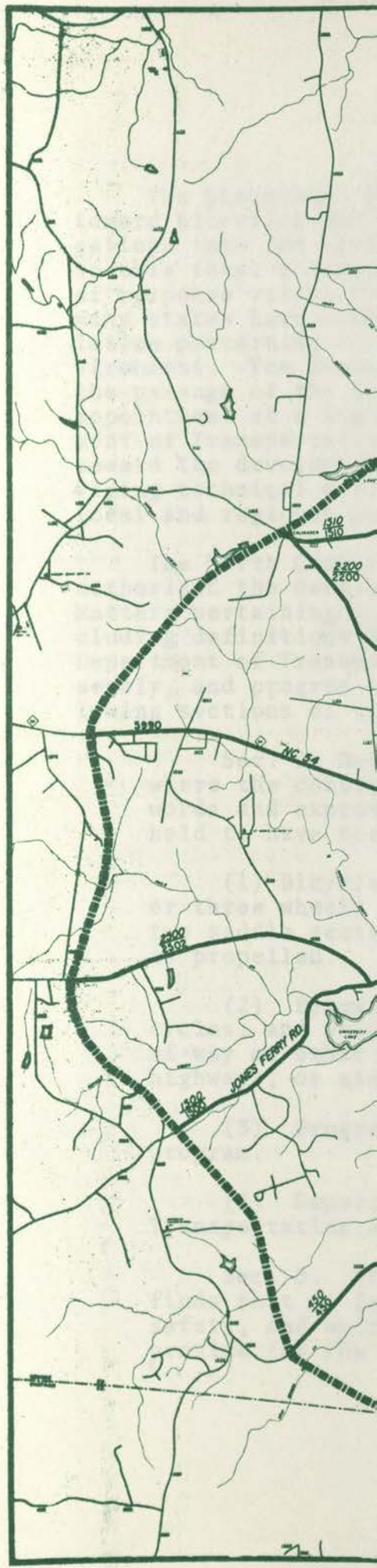


ALTERNATE PLAN "D"

BUS IMPACT ASSIGNMENT
ON RECOMMENDED PLAN

LEGEND

000	BUS IMPACT
000	1995 ASSIGNMENT

CHAPEL HILL INSET

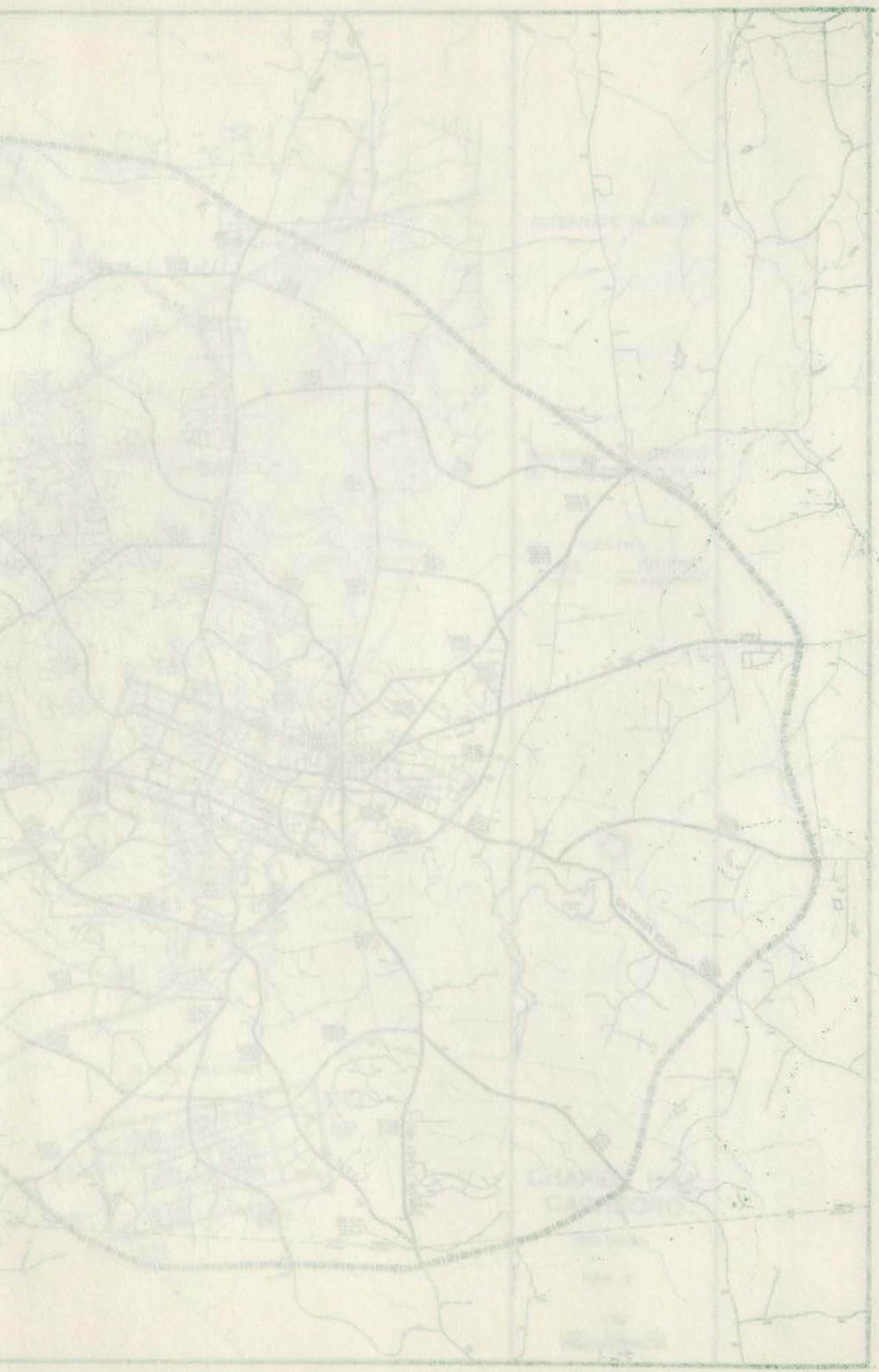
CHAPEL HILL
CARRBORO

NORTH CAROLINA

FIGURE 12

SCALE

0 FEET 2000 4000



The phenomenal public interest recently displayed toward bicycling has caused many states to begin investigations into the various roles that the bicycle could play in this total transportation system. Of course the type of response varies from state to state, but in general many states have either enacted or at least proposed legislation pertaining to certain aspects of the bicycling environment. The State of North Carolina's actions includes the passage of the Bicycle and Bikeway Act of 1974 and the appointment of a State Bicycle Coordinator in the Department of Transportation. Some of his duties will be oriented toward the development of a statewide bicycle program providing technical assistance, coordination, and funding to local and regional governments.

The North Carolina Bicycle and Bikeway Act of 1974 authorized the development of a bicycle and bikeway program. Matters pertaining to the bicycle and bikeway program including definitions of terms, duties of the North Carolina Department of Transportation, findings of the General Assembly, and program development are set forth in the following sections of the Act:

> Sec. 2. Definitions. As used in this act, except where the context clearly requires otherwise, the words and expressions defined in this section shall be held to have the meanings here given to them:
>
> (1) Bicycle: A non-motorized vehicle with two or three wheels tandem, a steering handle, one or two saddle seats, and pedals by which the vehicle is propelled.
>
> (2) Bikeway: A thoroughfare suitable for bicycles, and which may either exist within the right-of-way of other modes of transportation, such as highways, or along a separate and independent corridor.
>
> (3) Program: North Carolina bicycle and bikeway program.
>
> (4) Department: North Carolina Department of Transportation and Highway Safety.
>
> Sec. 3. Findings. The General Assembly hereby finds that it is in the public interest, health, safety, and welfare for the State to encourage and provide for the efficient and safe use of the bicycle;

and that to coordinate plans for bikeways most effectively with those of the State and local governments as they affect roads, streets, schools, parks and other publicly owned lands, abandoned roadbeds and conservation areas, while maximizing the benefits from the use of tax dollars, a single State agency, eligible to receive federal matching funds, should be designated to establish and maintain a Statewide bikeways program.

Sec. 4. Program Development. The Department is designated as such State agency, responsible for developing and coordinating the program.

Sec. 5. Bikeways may be designated along and upon the public roads.

Sec. 6. Funds. The General Assembly hereby authorizes the Department to include needed funds for the program in its annual budgets for fiscal years after June 30, 1975, subject to the approval of the General Assembly.

The Department is authorized to spend any federal, state, local, or private funds available to the Department and designated for the accomplishment of this act. Cities and towns may use any funds available.

The Bicycle Coordinator's Office of the Department of Transportation now leads the effort to implement the statewide bicycle and bikeway program as described in the Act of 1974.

Bicycle Interest, Activities, and Programs, Across North Carolina

Historically there seems to be at least four steps that must precede the implementation of any plan for bike routes, lanes, or paths.

These steps or stages of development are:

(1) Local interest as reflected in local bicycle clubs and other civic organizations.

(2) Local government takes notice as various interest groups pressure for action.

(3) Details of bike programs and plans are developed by local government and coordinated with the statewide program and plan.

(4) Search for means of funding the proposed plan.

Presently, step four above is the seminal problem because apparently there is a lack of plan implementation funds. However, many public officials across the State hold an optimistic view that funding sources will be discovered and that inevitably these sources will be available for implementation of planned bikeway facilities.

Table 15 displays the results of a canvas of local bicycle programs in some of the largest cities in North Carolina. It should be noted that apparently interest at the local level concerning bicycling or bicycle programs decreases as the size of the city decreases. However, in general it could be said that recommendations evolving from planning activities have been well received by local governments but as noted earlier the problem of funding is encountered as the cities initiate implementation action. Greensboro, Charlotte, and Winston-Salem have set aside special funds for their bicycle program. Many other cities have developed good bicycle plans and safety programs but invariably encounter the funding problem. Despite little money, Chapel Hill's bike program has made a successful response to some of the transportation demands in and around the University. Table 15 shows that seven cities have designated bikeways. These, for the most part, are bike routes.

Bicycle Planning in North Carolina

The role that the State of North Carolina perceives for itself in providing accommodations for cyclists is one of assistance to local governments, with whom the overall responsibility for building bicycle facilities and implementing bicycle programs resides. The philosophy being that the best and most effective decisions concerning bicycle accomodations are made on the local level. As a first step in keeping with this philosophy and playing its perceived role, the North Carolina Department of Transportation and Highway Safety has developed a planning and design handbook titled

TABLE 15

BICYCLE PROGRAM ACTIVITY BY CITY, AN UPDATE OF A SURVEY TAKEN IN AUGUST-SEPTEMBER 1973

CITIES[a] SURVEYED	HAS AN ACTIVE BICYCLE PROGRAM	HAS DESIGNATED BIKEWAYS	HAS PLANS FOR THE DEVELOPMENT OF BIKEWAYS EITHER IN PLANNED OR SPECIAL REPORTS	HAS ACTIVE CITIZENS GROUPS SUPPORTING BICYCLING
Charlotte	Yes	No	Yes	Yes
Greensboro	Yes	Yes	Yes	Yes
Winston-Salem	Yes	Yes	Yes	Yes
Raleigh	Yes	No	Yes	Yes
Durham	No	No	No	No
Asheville	No	No	No	Yes
Fayetteville	No	Yes	Yes	Yes
High Point	Yes	No	Yes	Yes
Gastonia	No	No	No	Yes
Wilmington	Yes	Yes	Yes	Yes
Kannapolis	No	No	No	No
Burlington	Yes	Yes	Yes	Yes
Rocky Mount	Yes	No	Yes	Yes
Wilson	No	Yes	Yes	Yes
Greenville	Yes	No	Yes	Yes
Goldsboro	No	No	No	Yes
Chapel Hill	Yes	Yes	Yes	Yes
Salisbury	No	No	No	Yes
Kinston	No	No	No	Yes
Hickory	No	No	No	No

Source: "Bikeways for North Carolina - Bicycle Program Requisites", Curtis B. Yates, North Carolina Department of Transportation, January, 1974 (Update)

[a] Cities ranked by population size.

The North Carolina Bicycle Facilities and Program Handbook[10]. The handbook offers technical information, recommendations, and suggestions to local citizen groups and officials in their development of local plans and programs.

Figure 13 indicates some general features and characteristics of bikeway facilities and also suggest that their overall planning and design process is as complex as any other mode of transportation. Herein lies the rationale for addressing such a wide range of topics in the ensuing handbook. The range of topics include:

(1) Organizing for Bicycle Planning
(2) Approaches for Citizen and Agency Involvement
(3) Bicycle System Planning Principles
(4) Bicycle Facility Engineering and Design Standards
(5) Maintenance and Operations Procedures
(6) Implementation and Funding Strategies
(7) Education and Related Programs
(8) Surveillance Programs and Plan Updating[11]

Bicycle Planning in the Chapel Hill-Carrboro Area

A strong public interest in bicycle transportation has developed in the Chapel Hill-Carrboro area. This interest becomes apparent when reviewing the results of citizen conducted surveys and is also reflected in discussions at public forums. There are many reasons for the bicycling interest displayed by Chapel Hill and Carrboro. First, the University is a dominant force over both towns. The bicycle has partially fulfilled some of the University's transportation needs thereby emphasizing its potential for future development. Second, the existence of a mild climate permits year-round bicycle usage. Third, topography has presented few obstacles in forms of major hills to be navigated enroute from surrounding areas to downtown Carrboro, downtown Chapel Hill, or to the University campus.

Bicycling interest throughout the Chapel Hill-Carrboro community has led to concern over the need for better provisions for bicycle riders. This concern has led certain

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[10] The North Carolina Bicycle Facilties and Program Handbook, North Carolina Department of Transportation, April 1975.

[11] Bicycle Boom...What To Do About It, Barton-Aschman Associates, Inc., September, 1974, p. 19.

interest groups to offer proposals for bicycle facilities that would provide more safety, convenience, and ease of operation for the bicyclists. Some of the specific proposals evolving from citizen surveys and needs study have been encompassed in an initial plan for greater provision for bicycle riding in Carrboro.

The plan has suggestions for (1) bicycle routes, lanes, and paths (2) street improvement and maintenance (3) public education concerning the rights of bicyclists (4) enforcement of rules-of-the-road and (5) administration of bicycle matters. The plan for bicycle routes, lanes, and paths basically calls for removal of on-street parking whenever necessary and relocation of lane markings giving one-way bicycle lanes on both sides of Weaver Street and Main Street. The possibility of widening Jones Ferry Road and North Greensboro Street allowing for bicycle lanes is explored. To accompany on-street bicycle lanes, it was suggested that utility right of way be utilized for bicycle paths--for example, alongside the Southern Railroad east of Greensboro Street.

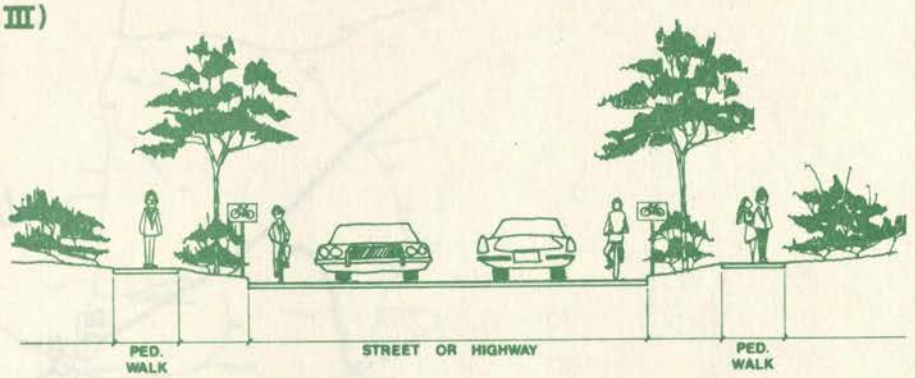
The bicycle plan proposed by Carrboro citizens reflected an attempt to coodinate their planned provisions for bicycles with those of Chapel Hill. The streets most used by bicycle commuters from Carrboro with downtown Chapel Hill or the University campus as destinations are Cameron, Pittsboro, Franklin, South Graham, and Ransom. To accommodate bicycles on these facilities, the proposal was similar to the one for Carrboro streets, which basically would remove on-street parking when necessary, relocate lane markings, and utilize existing right of way for bicycle paths when possible.

There is by no means less interest in bicycling and planning for bicycle facilities in Chapel Hill than in Carrboro. A short time ago Chapel Hill implemented a system of bike routes and paths. Presently, the bicycle paths are the sidewalk rights-of-way along major streets leading into the CBD and the University Campus. Pedestrians, of course, have the right of way, but bicyclists may ride on the sidewalks along the following facilities: South Columbia Street, Raleigh Street, Cameron Street, West Franklin Street, part of East Franklin Street, Raleigh Road, Country Club Road, and Airport Road.

The results of an origin-destination study of bicycle trips as conducted by the City and Regional Planning Department of UNC is tabulated in Table 16 and graphically illustrated in Figure 14. The district composition for this study is shown in Table 17. This study is somewhat indicative

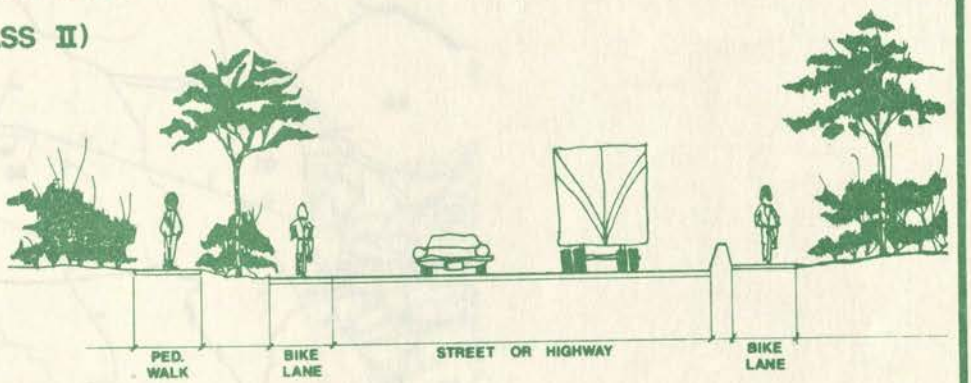
BIKE ROUTE

(CLASS III)



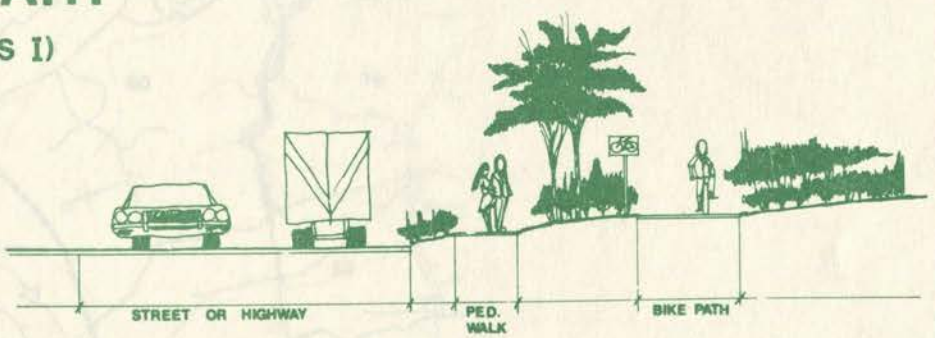
BIKE LANE

(CLASS II)



BIKE PATH

(CLASS I)



CURRENT BIKEWAY FACILITY DESIGN OPTIONS

Figure 13

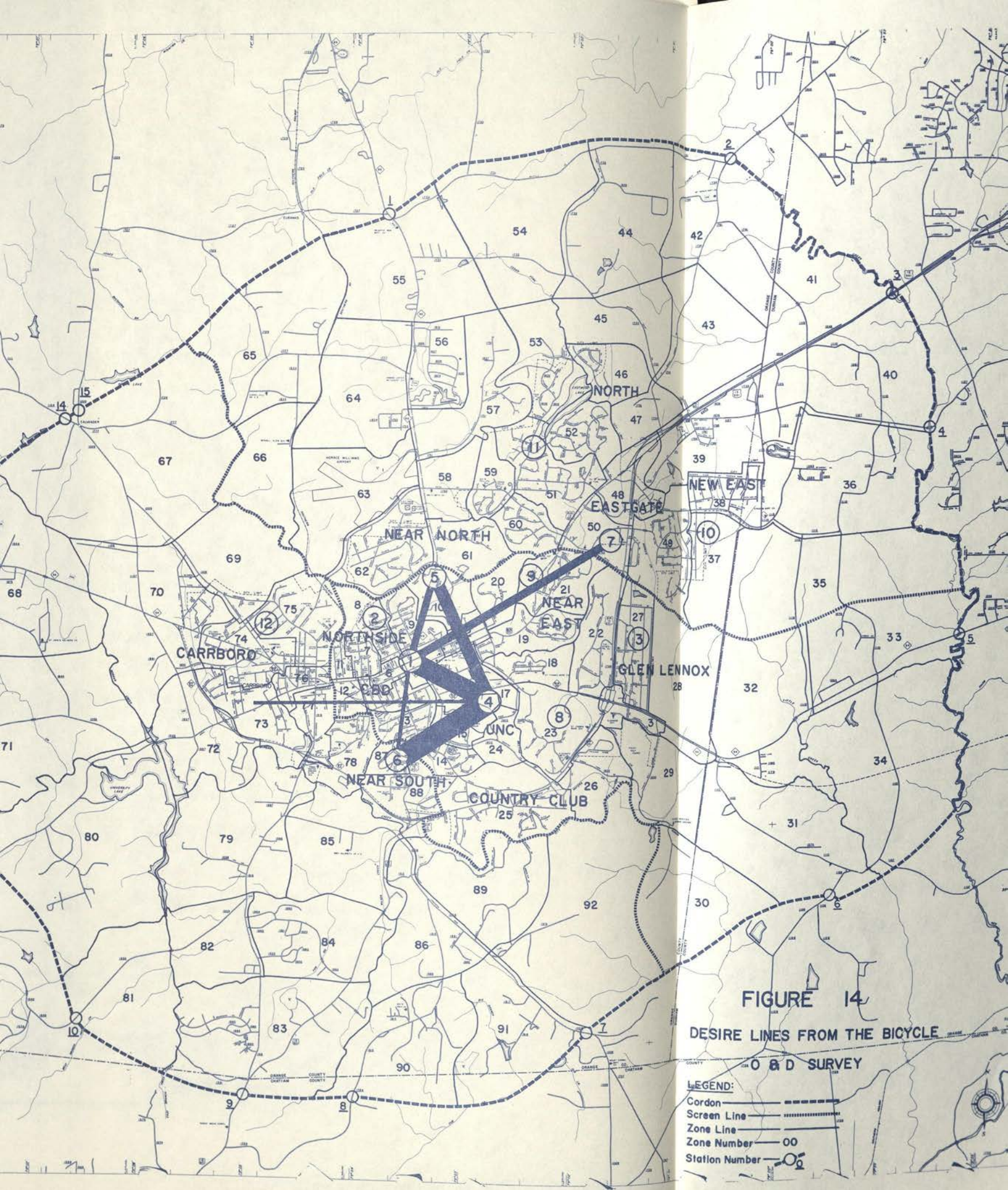


FIGURE 14

DESIRE LINES FROM THE BICYCLE O & D SURVEY

TABLE 16

BICYCLE ORIGIN AND DESTINATION DATA

DISTRICT OF ORIGIN \ DISTRICT OF DESTINATION (INTERNAL TRIPS)	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
1	663	72	0	459	135	64	217	0	64	0	22	39	1736
2	72	0	0	54	0	0	0	0	0	0	0	18	145
3	0	0	32	0	0	0	0	0	0	0	0	0	32
4	772	18	0	347	379	599	0	22	0	0	0	105	2141
5	54	0	0	460	27	0	0	1	0	0	0	0	541
6	105	0	0	579	0	21	0	0	0	0	0	0	727
7	166	0	0	72	0	0	0	0	0	0	24	0	262
8	0	0	0	44	0	0	0	0	0	0	0	0	44
9	27	0	0	37	0	0	18	0	0	0	0	0	82
10	0	0	0	0	0	0	0	0	0	81	0	0	81
11	22	0	0	0	0	0	0	0	0	0	143	0	164
12	19	0	0	58	27	41	0	0	0	0	0	253	399

TABLE 17

DISTRICT COMPOSITION		
District	District Number	Zones Included in District
CBD	1	1,2,5,6,12
North Side	2	7,8,11
Glen Lennox	3	3,27
UNC	4	4,15,16,17,24
Near North	5	7,10,61,62
Near South	6	13,14,78,87,88
East Gate	7	48,50
Country Club	8	18,22,23,25,26
Near East	9	19,20,21,60
New East	10	38,39,37,47,49
North	11	46,51,52,53,58,59
Carrboro	12	69,70,73,74,75,76,77

of the effort made at the local level in planning for bicyclists. The only desire lines shown in Figure 14 are those that have a demand of one hundred or more bicycle trips per day. Besides the inter-district travel, there was intra-district demand for the following districts:

(1) 663 trips
(2) 347 trips
(3) 143 trips
(4) 253 trips

It should be pointed out that this origin-destination survey was made during the summer months when UNC student enrollment was at a low point. The magnitude of bicycle traffic could be expected to increase substantially during the school year. However, the general direction of the desire lines is not expected to be seasonably dependent. Based on this origin-destination study, it has been recommended that specific consideration be given to those roads or streets that lie in or near the desire line corridors whenever the transportation planning process calls for making provisions for bicycle travel.

Many citizens in the Chapel Hill-Carrboro planning area believe that in their community the bicycle can be more convenient, economical, and sometimes even a faster mode of transportation than the auto. There is little reason to believe that the bicycle cannot become in the future a viable part of the Chapel Hill-Carrboro transportation system. Even now, the Federal and State governments are acting to provide funds, improved legislation, and technical assistance to local governments. Perhaps even more important to the realization of community bicycle goals is that the citizens of the Chapel Hill-Carrboro Area have resolved themselves to full integration of bicycle facilities and programs with the total transportation plan on a cooperative, comprehensive, and continuing basis.

VI. EVALUATION OF ALTERNATIVE THOROUGHFARE PLANS RELATIVE TO SOCIAL, ECONOMIC, AND ENVIRONMENTAL IMPACTS

Increased social awareness and concern for the environment have added to the complexity of transportation decision making, particularly in urban areas. Several alternative plans were considered before a finalized plan was settled upon. This chapter will discuss these several alternative plans, their physical characteristics and their social, economic, and environmental effects. Each alternative plan will be considered in the light of their effect on the planning area in such categories as: regional and community growth; conservation and preservation; public facilities and services; community cohesion; displacement of residences and businesses; air, noise, and water pollution; aesthetic values; public health and safety; national defense; and the plan's suitability to provide an economical, safe, and efficient transportation system.

Physical Characteristics of the Alternative Thoroughfare Plans

Plan A - Existing Major Street System

Alternate Plan "A" (Figure 15) consists of the existing major street system. This system would be the network of streets that would have to serve 1995 travel desires if no new facilities are considered. Alternate "A" is useful to illustrate existing and expected future locations of capacity deficiency, utilizing the assignment of both existing and projected design year traffic on the existing network.

Design year traffic on existing streets would be intolerable. All major streets would be near or over capacity.

The costs incurred by Plan "A" would be those of maintenance and widening of the existing streets. Without major improvements to the existing network, projected traffic volumes are expected to cause widespread, intolerable congestion resulting in an excessive noise level, increased air pollution levels, decreased public safety, and a totally inefficient traffic system.

Plan B - Existing Thoroughfare Plan

Alternate Plan "B" (Figure 16) was developed in 1964.

The proposed major features of the plan include:

(1) The extension of SR 1843 and Franklin Street

(2) Connectors between Merritt Mill Road and Greensboro Street

(3) Connector between Rosemary Street and Franklin Street

(4) Extension of NC 54 Bypass eastward to Airport Road

(5) A long range outer loop system

A level of service "D" would be tolerated on existing streets under Plan "B". This level of service represents traffic operations at a level normally used for urban area transportation planning. At this level of service operating conditions approach unstable flow with tolerable operating speeds being maintained though considerably affected by changes in operating conditions. Fluctuations in volume and temporary restrictions to flow may cause a substantial drop in operating speeds. Drivers have little freedom to maneuver and comfort and convenience are low, but these conditions can be tolerated for short periods of time.

The assignment of 1995 traffic to Plan "B" indicated that substantial problems still existed and that several important existing streets would still require disruptive widening. Existing streets that would require widening under Plan "B" are:

(1) Smith Level Road from US 15-501 to NC 54 Bypass would require widening to four travel lanes

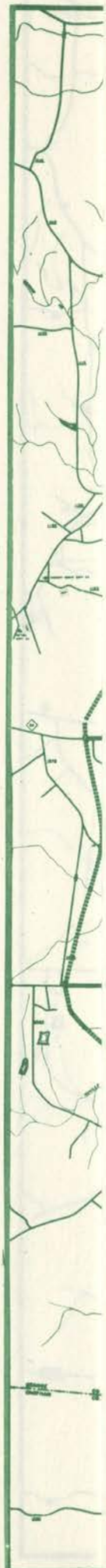
(2) Pittsboro Street would have to be widened to more than seven travel lanes

(3) Airport Road from North Street to Umstead Drive would require more than seven travel lanes and six lanes from Umstead Drive to Estes Drive

(4) Estes Extention (SR 1780) from Airport Road to Umstead Drive would require widening to four travel lanes

(5) Merritt Mill Road from Greensboro Street to Franklin Street would require widening to a five-lane urban section

(6) McCauley Street from Columbia Street to Brookside Drive would require widening to a six-lane urban section plus exclusive turn lanes



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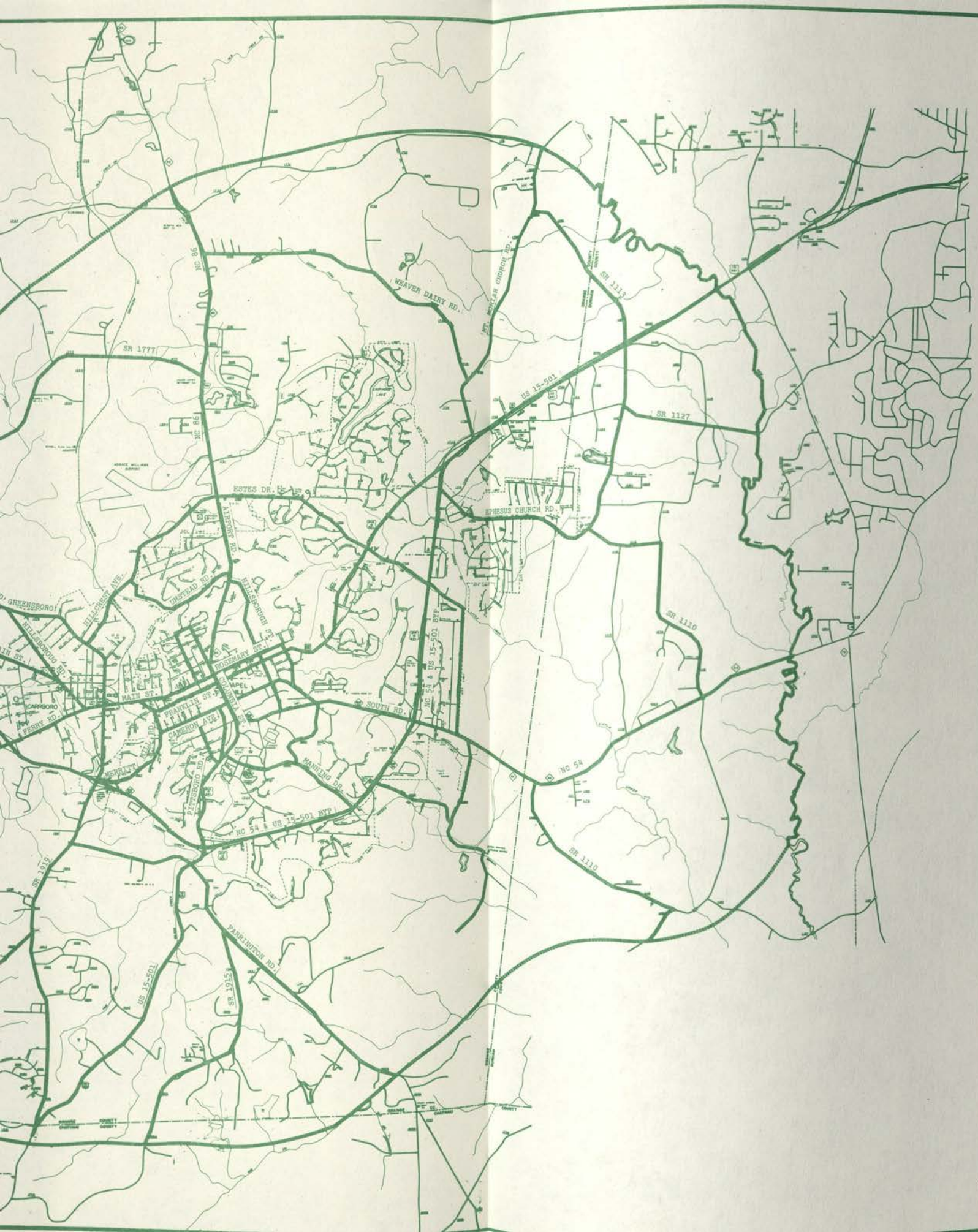
ttsboro Street would have to be widened to re than seven travel lanes

rport Road from North Street to Umstead Drive uld require more than seven travel lanes and x lanes from Umstead Drive to Estes Drive

tes Extention (SR 1780) from Airport Road to stead Drive would require widening to four avel lanes

rritt Mill Road from Greensboro Street to anklin Street would require widening to a ve-lane urban section

Cauley Street from Columbia Street to Brookside ive would require widening to a six-lane urban ction plus exclusive turn lanes



ALTERNATE
THOROUGHFARE PL
"A"

EXISTING MAJO
STREET SYSTEM

LEGEND

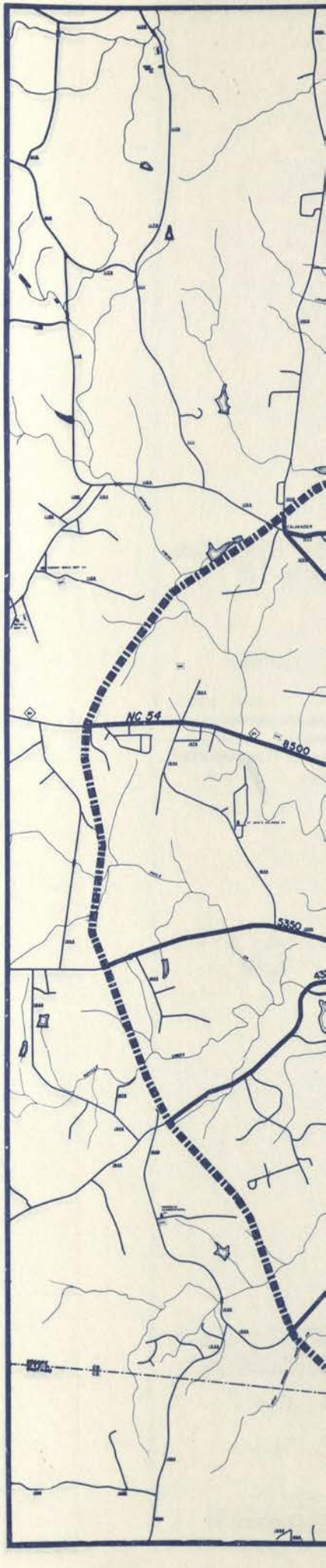
EXTERNAL CORD
MAJOR STREET

CHAPEL HIL
CARRBORO

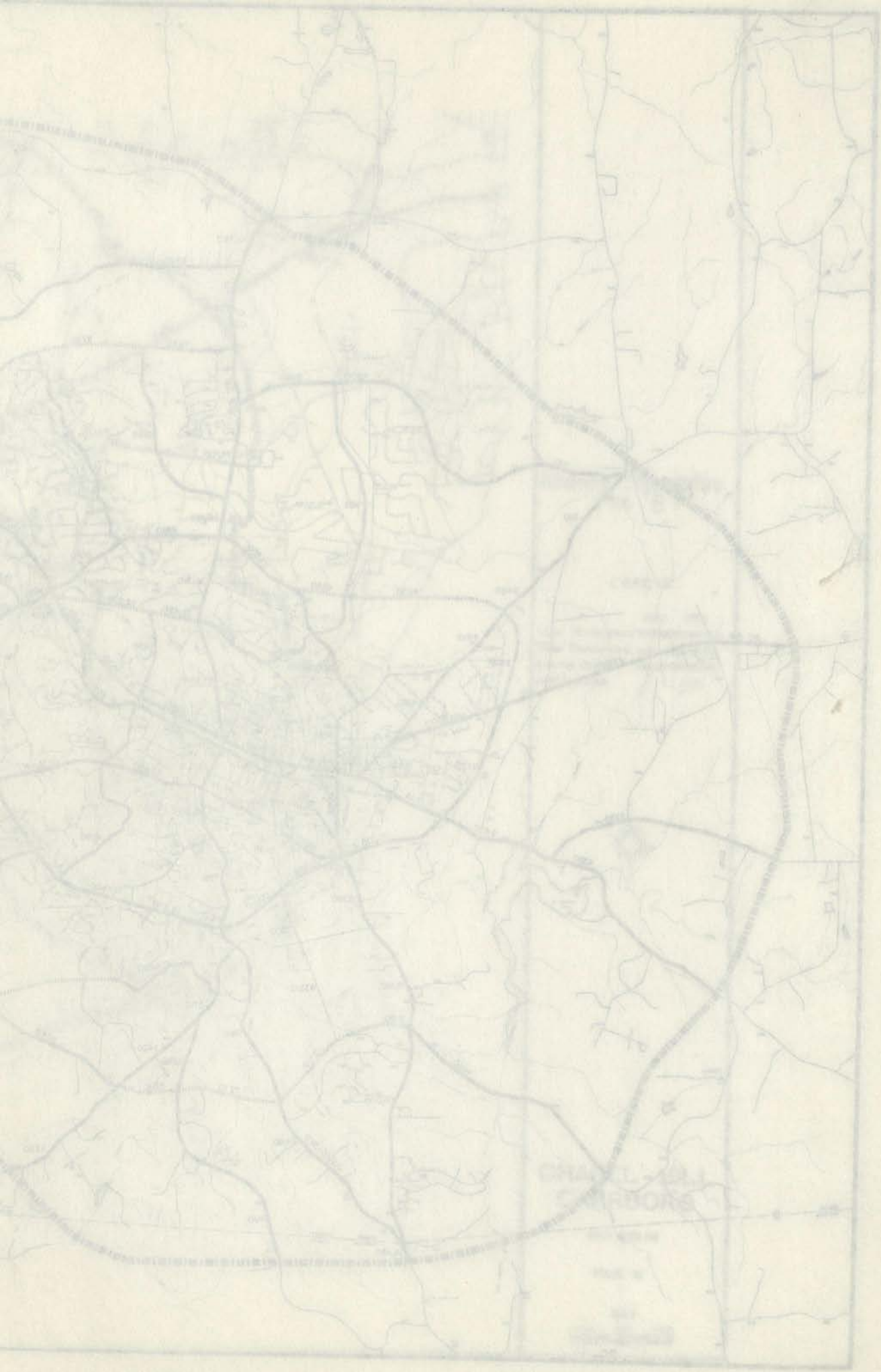
NORTH CAROLINA

FIGURE 15

SCALE
0 FEET 2000 4000


NC 54
8500
5350


Alternate Thoroughf
Plan "B"
LEGEND
Exist.
Major Thoroughfare
Minor Thoroughfare
External Cordon
1995 Volumes
CHAPEL H
CARRBOR
NORTH CAROLINA
FIGURE 16
SCALE
0 FEET 2000
US 15-501
BYP 54
NC 86
CHAPEL HILL
CARRBORO
ORANGE COUNTY
CHATHAM COUNTY



(7) NC 54 Bypass from Jones Ferry Road to US 15-501 Business would require widening to four travel lanes

(8) US 15-501 Bypass from US 15-501 Business to NC 54 would require widening to four travel lanes and from NC 54 to US 15-501 would require six travel lanes

(9) South Road from Country Club Road to Columbia Street would require widening to six lanes with additional turn lanes at intersections

(10) Ephesus Church Road would require three travel lanes from Bambury Lane to the Outer Loop

(11) NC 54 East from SR 1110 to the cordon line would require four travel lanes

(12) NC 54 Business from Greenwood Road to Country Club Road will require widening to five travel lanes

Plan C

Alternate Plan "C" (Figure 17) is a refinement of Alternate Plan "B". Much of the new construction proposed in Plan "B" is also a characteristic of Plan "C". Plan "C", like Plan "B", utilizes a large percentage of the existing street mileage in conjunction with proposed new construction. A level of service "D" would be tolerated on the existing streets utilized by Plan "C", while new construction will have a minimum level of service "C".

The significant features that differentiate Plan "B" and Plan "C" involves the deletion, relocation, or realignment of proposed new construction which would have created adverse environmental or topographical conditions in Plan "B". Those major changes incorporated in Plan "C" as opposed to Plan "B" are:

(1) Relocation of SR 1843 Extension to the west of the Southern Railway facility

(2) Deletion of the Umstead Drive Extension from Airport Road to US 15-501 Business

(3) Deletion of Boundary Street Extension northward

(4) Deletion of Rosemary Street Connector to US 15-501 Business at Howell Lane

(5) Deletion of the connector between NC 54 Bypass and Merritt Mill Road

(6) Deletion of the connector between SR 1009 and SR 1780

(7) Realignment of Bayberry Drive Extension

(8) Construction of Manning Drive Extension from US 15-501 Bypass to the proposed Outer Loop

(9) Inclusion of Hillsborough Street on this alternate plan

(10) Extension of Pittsboro Street to Pritchard Street and subsequently a one-way pairing of this facility with Columbia Street.

The assignment of 1995 traffic to Plan "C" shows a better distribution of traffic volumes as opposed to Plan "B". However, it should be noted that the deletions listed above caused even greater volumes on McCauley Street and South Road which were already heavily burdened in Plan "B".

These high traffic projections on many existing streets will necessitate widening of these streets, but widening called for in Plan "C" should prove to be of much greater benefit in overall traffic efficiency than either Plan "A" or Plan "B". Existing streets which would require widening under Plan "C" are as follows:

(1) Pittsboro Street would have to be widened to three lanes

(2) Smith Level Road from US 15-501 to NC 54 Bypass would require widening to four travel lanes

(3) Airport Road from Hillsborough Street to Estes Drive would require six travel lanes

(4) Merritt Mill Road from Greensboro Street to Franklin Street would require six travel lanes

(5) McCauley Street from Columbia Street to Brookside Drive would require more than seven lanes

(6) NC 54 Bypass from Jones Ferry Road to US 15-501 Business would require widening to four travel lanes

Deletion of Rosemary Street Connector to US 15-501 Business at Howell Lane

Deletion of the connector between NC 54 Bypass and Merritt Mill Road

Deletion of the connector between SR 1009 and SR 1780

Realignment of Bayberry Drive Extension

Construction of Manning Drive Extension from US 15-501 Bypass to the proposed Outer Loop

Inclusion of Hillsborough Street on this alternate plan

Extension of Pittsboro Street to Pritchard Street and subsequently a one-way pairing of this facility with Columbia Street.

Assignment of 1995 traffic to Plan "C" shows a distribution of traffic volumes as opposed to Plan "B". However, it should be noted that the deletions listed would add even greater volumes on McCauley Street and Franklin Street which were already heavily burdened in Plan "B".

Although high traffic projections on many existing streets would necessitate widening of these streets, widening of streets in Plan "C" should prove to be of much greater benefit to overall traffic efficiency than either Plan "A" or Plan "B". Existing streets which would require widening in Plan "C" are as follows:

Pittsboro Street would have to be widened to three lanes

Smith Level Road from US 15-501 to NC 54 Bypass would require widening to four travel lanes

Airport Road from Hillsborough Street to Estes Drive would require six travel lanes

Merritt Mill Road from Greensboro Street to Franklin Street would require six travel lanes

McCauley Street from Columbia Street to Brookside Drive would require more than seven lanes

NC 54 Bypass from Jones Ferry Road to US 15-501 Business would require widening to four travel lanes


Alternate Thoroug
Plan "C"
LEGEND
Exist.
Major Thoroughfare
Minor Thoroughfare
External Cordon
1995 Volumes
CHAPEL H
CARRBOR
NORTH CAROLINA
FIGURE 17
SCALE
0 FEET 2000

(7) US 15-501 Bypass from US 15-501 Business to NC 54 would require widening to four travel lanes and from NC 54 to US 15-501 would require six travel lanes

(8) South Road from Country Club Road to Columbia Street would require widening to more than seven lanes with additional turn lanes at intersections

(9) Country Club Road would require four travel lanes

(10) Manning Drive would need three travel lanes from Ridge Road to US 15-501 Bypass

(11) Ephesus Church Road would need more than two travel lanes

(12) Estes Drive would require more than two travel lanes

(13) Hillsborough Street from Rosemary Street to Airport Road requires more than two travel lanes

(14) NC 54 East from SR 1110 to the cordon line would require four travel lanes

(15) NC 54 Business from Greenwood Road to Columbia Street will require widening to five travel lanes

Plan D - The Recommended Thoroughfare Plan

Alternate Plan "D" (Figure 18) is the recommended thoroughfare plan for Chapel Hill and Carrboro. This plan is a refinement of Plan "C". Plan "D" includes a few major changes in the overall thoroughfare concept as set forth in Plan "C". Changes made are those of alignment shifts, deletions, and subsequent minor additions. The changes that Plan "D" incorporated were designed to provide better access to the planning area, continuity within the system, and maximum traffic service within the planning area. The alignment changes in Plan "D" were made as a result of functional design work done on topographic mapping of the area. The additions and deletions that were made should enhance traffic flow conditions throughout the area.

The significant differences in Plan "D" as opposed to Plan "C" are:

(1) Realignment of Piney Mountain Road Extension

(2) Deletion of SR 1816 Extension to SR 1734

(3) Deletion of Curtis Road and Lake Shore Drive from the plan

(4) Deletion of proposed connector between Outer Loop and NC 54 Bypass

(5) Deletion of Manning Drive Extension from US 15-501 Bypass to the Outer Loop

(6) Relignment of Bayberry Drive Extension

(7) Addition of Boundary Street and Park Place to the plan with a connector enhancing alignment between these facilities

(8) Addition of a connector between SR 1009 and the Extension of SR 1843

(9) Inclusion of all of Umstead Drive on the plan

Existing streets which require widening under Plan "D" are as follows:

(1) Columbia Street will require widening to three lanes from NC 54 Business to Cameron Avenue

(2) Pittsboro Street will have to be widened to three lanes

(3) Smith Level Road (SR 1919) will require four travel lanes from SR 1939 to NC 54 Bypass and five travel lanes from NC 54 Bypass to Main Street

(4) NC 86 will require five travel lanes from Barclay Road to Homestead Road (SR 1777) and four travel lanes from Homestead Road to the cordon line

(5) US 15-501 Business from Park Place to US 15-501 Bypass will require five travel lanes with additional turn lanes at intersections

(6) US 15-501 will require widening to four travel lanes from the cordon line (south) to US 15-501 Bypass

(7) NC 54 Business from Greenwood Road to Columbia Street will require widening to five travel lanes

(8) NC 54 Bypass from Jones Ferry Road to US 15-501 north would require widening to four travel lanes

eletion of Curtis Road and Lake Shore Drive
rom the plan

eletion of proposed connector between Outer
oop and NC 54 Bypass

eletion of Manning Drive Extension from US 15-
01 Bypass to the Outer Loop

elignment of Bayberry Drive Extension

ddition of Boundary Street and Park Place to
he plan with a connector enhancing alignment
etween these facilities

ddition of a connector between SR 1009 and the
xtension of SR 1843

nclusion of all of Umstead Drive on the plan

ng streets which require widening under Plan "D"
ows:

olumbia Street will require widening to three
anes from NC 54 Business to Cameron Avenue

ittsboro Street will have to be widened to three
anes

mith Level Road (SR 1919) will require four travel
anes from SR 1939 to NC 54 Bypass and five travel
anes from NC 54 Bypass to Main Street

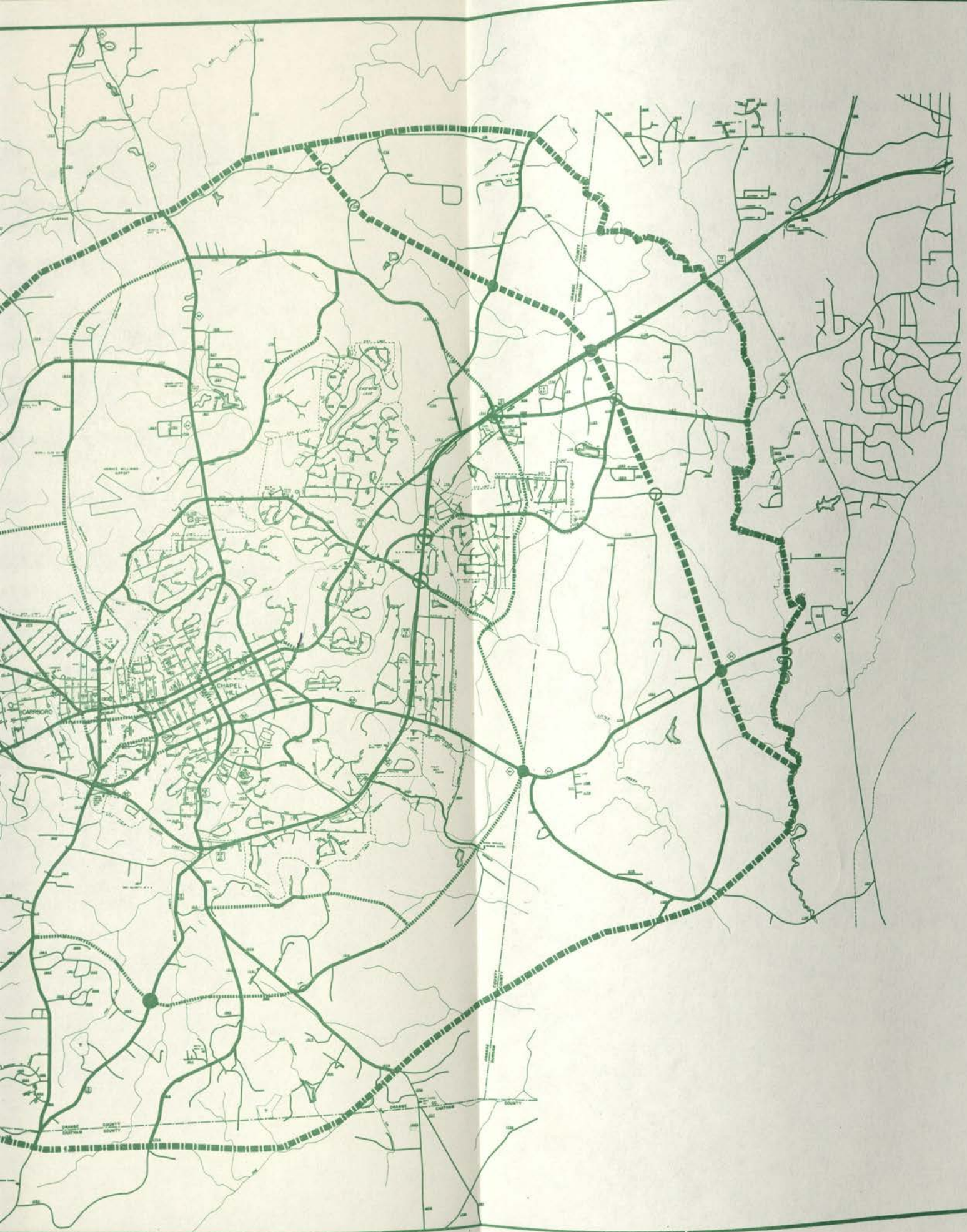
NC 86 will require five travel lanes from Barclay
Road to Homestead Road (SR 1777) and four travel
lanes from Homestead Road to the cordon line

US 15-501 Business from Park Place to US 15-501
Bypass will require five travel lanes with addi-
tional turn lanes at intersections

US 15-501 will require widening to four travel
lanes from the cordon line (south) to US 15-501
Bypass

NC 54 Business from Greenwood Road to Columbia
Street will require widening to five travel lanes

NC 54 Bypass from Jones Ferry Road to US 15-501
north would require widening to four travel lanes



Recommended Plan "D"

LEGEND

EXTERNAL CORDON

FREEWAY

EXISTING

PROPOSED

MAJOR THOROUGHFARE

MINOR THOROUGHFARE

INTERCHANGE

GRADE SEPARATION

N

S

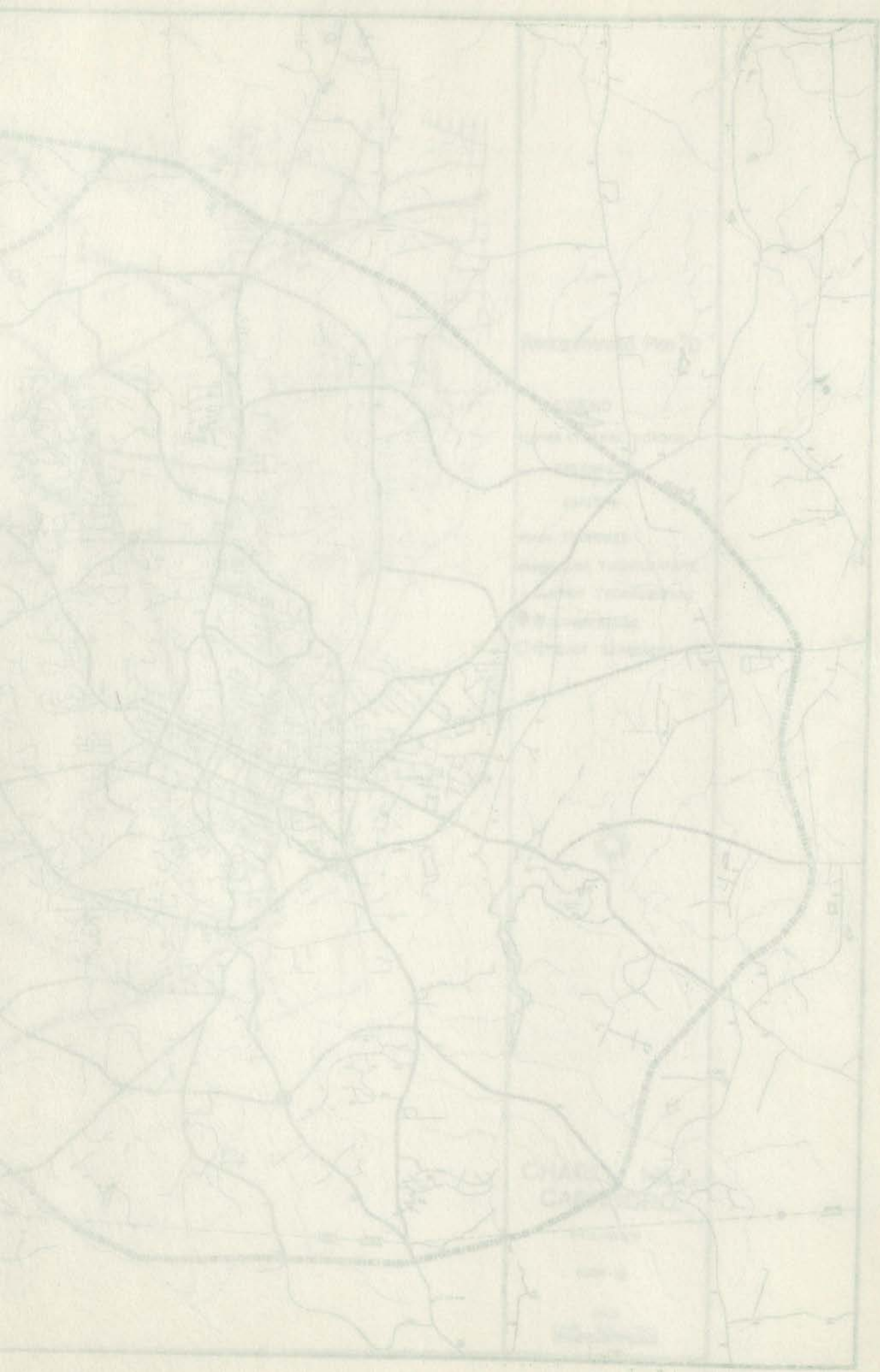
CHAPEL HIL
CARRBORO

NORTH CAROLINA

FIGURE 18

SCALE

0 FEET 2000 4000



(9) Merritt Mill Road from Greensboro Street to Franklin Street will require four travel lanes

(10) McCauley Street from Columbia Street to Pritchard Street will require four travel lanes

(11) Estes Drive from NC 86 to US 15-501 Bypass will require four travel lanes

(12) Hillsborough Street from Rosemary Street to Airport Road will require four travel lanes

(13) Raleigh Street from South Road to Rosemary Street will require four travel lanes

(14) NC 54 East will require four travel lanes from SR 1110 to the cordon line

(15) Weaver Dairy Road will require four travel lanes

Public Input Into Proposed Thoroughfare Plan

It is a policy of the North Carolina Department of Transportation to gain as much citizen participation in the transportation planning process as possible. The North Carolina Highway Action Plan sets forth a number of methods by which local public opinions may be introduced into the planning process. During the Chapel Hill-Carrboro study, three methods outlined in the "Action Plan" were utilized to gain public input. These included goals and objectives survey, meetings with local officials, planning staff, and planning board, and public meetings for the general public.

During the course of the Chapel Hill-Carrboro study, continuous coordination was maintained with the planning staffs of Chapel Hill and Carrboro. A wide range of information needed for the study was provided by the planning departments in addition to input of expertise on many local problems and situations. Meetings of note held in Chapel Hill and Carrboro include:

(1) Public Forum in Chapel Hill, January 15, 1974.

(2) Public Forum in Chapel Hill, February 19, 1974.

(3) Public Meeting in Carrboro, November 20, 1974.

(4) Staff meeting with UNC, Town of Chapel Hill and NCDOT, June 18, 1975.

During these meetings the formulation of the alternative plans and their subsequent development were discussed in detail. Several suggestions, observations, and comments regarding alternative plans were made at each of these meetings. There was a general consensus that Plan "D" was the best plan for Chapel Hill and Carrboro. The most significant points of contention concerning the recommended plan were:

(1) One-way pairing of Pittsboro and Columbia Streets

(2) One-way pairing of Franklin and Rosemary Streets

(3) Widening of South Road on UNC-Campus

Social and Economic Impacts of the Alternative Thoroughfare Plans

Economy and Employment

Implementation of the alternative thoroughfare plans would have varying effects on the planning area economy, both positive and negative. In the negative sense, there would be some disruption of commercial establishments resulting from major street widening and new street construction. Most commercial concerns which will be displaced by suggested improvements are generally of fair to poor structural quality. The positive effect would be the enhancement and improvement of commerce resulting from an improved transportation system.

The number of commercial establishments which would be displaced under full implementation of each alternative thoroughfare plan is shown in Table 18. This table readily points out that Plan "B" would be the most disruptive, affecting an estimated 23 commercial establishments and 115 employees in the planning area. Alternate Plan "D", the recommended plan, would be the least disruptive affecting only 21 existing commercial establishments with an estimated 100 employees. A survey by the Right of Way Branch, Division of Highways, North Carolina Department of Transportation, revealed that suitable replacement quarters would be available for those establishments displaced by highway improvements.

TABLE 18

Selected Environmental Effects of Alternative Thoroughfare Plans

	Plan A	Plan B	Plan C	Plan D
Total Miles in Thoroughfare System	92.8	111.6	111.0	110.9
Major Thoroughfares	-	104.1	104.3	107.7
Minor Thoroughfares	-	7.5	6.7	3.2
Total Miles of Street Construction	-	40.4	43.1	48.4
Widening	-	20.1	22.1	30.6
New Location	-	20.3	21.0	17.8
Estimated Number of Businesses Displaced	4	23	21	21
Estimated Number of Homes Displaced	36	73	63	65
Estimated Number of Churches Affected	20	23	23	23
Estimated Number of Schools Affected	7	9	9	9
Estimated Number of Recreation Areas Affected	7	9	9	9
Estimated Number of Employees Displaced	25	115	120	100
Estimated Number of Persons Displaced (White)	72	145	125	135
Estimated Number of Persons Displaced (Non White)	28	55	45	50

A comparison of all four plans, indicates only a slight difference in the number of businesses disrupted. The real difference in the economic impacts imparted by the different plans is depicted by the quality of service and location of transportation services. Plan "A", the "do nothing" alternative (widening only) would have the least positive economic impact in that new areas would not be opened up for possible new commercial development. Plan "B" has a relatively large business displacement in comparison with Plan "D". Plan "D" would open up new areas for planned development and would provide better service to existing commercial and industrial establishments. Plan "D" would provide a fast, safe, and efficient transportation system which could encourage further commercial and industrial development if desirable. Increased development would provide jobs for area residents and additional capital injections in the area's economic system.

The need for additional right-of-way caused by implementation of the recommended thoroughfare plan will cause a decrease in the area's tax base. This initial loss in revenue, however, should be more than offset by the increased valuation of remaining properties due to increased development and the existence of an effective transportation system.

Housing and Community Cohesion

The estimated displacement of homes and persons for each alternative plan is listed in Table 18. Recommended Plan "D" will require the dislocation of approximately 65 dwelling units, about 1% of the planning area total. Plans "C" and "A" affect fewer dwelling units than the other alternative thoroughfare plans.

Relocation of individuals affected should not present any special problems in view of the relatively small number of dwelling units affected and the ready availability of adequate replacement housing and relocation assistance. The vacancy rate in Orange County is approximately 2.6% based on the 1970 Census. It is assumed that the rate within the planning area is similar, although seasonal fluctations may occur.

Alternate Plan "A" would require the least number of relocations; however, it would greatly affect the front yards, shrubs, trees, and other vegetation, and the aesthetics of the neighborhood of the remaining dwelling units. In addition, noise and air pollution would increase for those dwellings not moved because of their relatively closer position to the widened street.

Alternate Plan "B" would cause the disruption of several existing residential patterns. This would be caused by extensive widening on Merritt Mill Road, Pittsboro Street, and Airport Road. The greatest detriment of this widening would be to cause a decline in the character of the neighborhoods through the loss of front yards and the closer proximity of traffic to the residences.

Alternate Plan "C" will cause less relocation than Alternate Plan "B". However, the added congestion on South Road and McCauley Street would force more traffic onto side streets, thus creating a potentially disrupting effect on several neighborhoods.

Alternate Plan "D" will do little to disrupt established neighborhoods and cohesive communities. It is unlikely that the implementation of the recommended thoroughfare system will cause a decline in the character or stability of existing neighborhoods. This lessening of detrimental effects is due to at least two aspects of the recommended plan: (1) the positive effects of judicious widening are magnified with the use of new location in areas not fully developed, and (2) the development of one-way pairs. The one-way pair concept has the further effect of reducing traffic on a particular street relative to two-way traffic on the same street. This tends to reduce the noise level and the amount of emissions for the individual street in a given location.

Although Table 18 shows no environmental effect due to improvements under Alternate Plan "A", it is expected that there will be detrimental effects through the lack of improvement. Traffic will tend to move slower as the ADT increases. This slower movement should increase noise and emissions from vehicles in a given location. Traffic will seek residential streets for use as through streets to escape the slower moving traffic on the major thoroughfares. The entire system and development within the system will suffer from this overloading and misuse of various streets in the network.

School and Churches

The number of schools and churches which will be affected by the alternative thoroughfare plans are also listed in Table 18. There is very little difference in the

number of schools and churches affected under the different plans. Under Plan "D", 23 churches and 9 schools will be affected by street improvements. None of these facilities will require relocation nor will they suffer extreme adverse effects due to improvements. The facilities involved will encounter somewhat higher noise levels but it is not anticipated that present noise pollution standards will be exceeded. This subject will be dealt with in greater detail later in this chapter.

The affected schools and churches will, for the most part, encounter increased traffic volumes. These volumes, however, would increase with or without the recommended improvements, in which case, the streets would suffer increased congestion, without the benefits of added safety and efficiency provided by the recommended improvements. The proposed improvements should provide better accessibility to all schools and churches.

Parks and Recreational Facilities

The recommended thoroughfare plan, Plan "D", provides the best traffic service to area parks and recreational facilities. The recreational facilities include University Lake, city and school playgrounds, city parks, Chapel Hill Country Club, and two golf courses. New construction or street widening should have little adverse affect on these recreational areas.

Public Utilities

The improvements recommended by each plan will necessarily cause the relocation of public utilities located adjacent to the roadway. A relative measure of each alternative thoroughfare plan's effect on public utilities can be obtained by comparing the miles of widening required under each of the plans. Construction on new location will cause some utilities relocation but not as extensively as widening projects. Table 18 indicates that there would be little difference in the magnitude of utilities relocation under any of the alternative plans. Utilities relocation cost have been included in the right-of-way estimate for Plan "D".

It is recommended that any utility lines which must be adjusted or relocated be shown on the individual project plans. Utility company representatives and/or other officials responsible for these utilities should be contacted in order to implement relocation procedures. Adjustment and relocation should be completed, insofar as possible,

prior to commencement of project construction. This procedure will minimize or perhaps eliminate potential disruptions in utility services.

Public Health and Safety

A transportation system can contribute to the public health and safety through (1) a reduction in traffic accicents, (2) improved access to medical facilities, and (3) improved mobility for fire, police, and other emergency vehicles.

Plan "A" would contribute the least to improving traffic safety and mobility by tolerating a lower level of service and by concentrating large volumes of traffic on a few major streets. In many instances, elements of Plan "A" would not be operable because of congestion. Plans "B", "C", and "D" would all provide better access in and around the area in varying degrees. Plan "D", however, should contribute most toward improving traffic safety and mobility, by distributing traffic loads more equally over the entire system and correspondingly reducing intersection overloads.

Plan "D" improvements on major radial routes and the provision of an outer loop should provide increased mobility to outlying areas for police, fire, and rescue vehicles.

National Defense

In accordance with federal guidelines, PPM 50-6.1, the North Carolina Department of Transportation has designated US 15-501 as a National Defense Highway. It is anticipated that the proposed I-40 Bypass will be incorporated into the Defense Highway System upon its implementation.

Alternate Plan "D" provides a better system for efficient evacuation and movement around and within the area than do the other alternative plans. See Figure 19.

Environmental Effects

Air Quality

Air quality studies have reported that the internal combustion engine used in motor vehicles causes approximately three-fourths of the carbon monoxide, half the hydrocarbons, and nearly half the nitrogen oxides in the atmosphere. Since the passage of the Federal Air Quality Act of 1967, there has been extensive research for means to reduce these pollutant emissions. The Federal government has set increasingly stringent standards on emissions from new automobiles. New automobiles are being equipped with pollution devices to substantually reduce emission.

The design of a thoroughfare system can have a significant effect on the amount of pollutants added to the atmosphere. Pollutant emissions are reduced whenever traffic is permitted to flow smoothly, or by reduction of congestion and stop-and-go driving conditions. These reduction of pollutants is created by the more efficient use of fuel offered by free flowing conditions. The effect of congestion on automobile emissions is shown in figure 20.

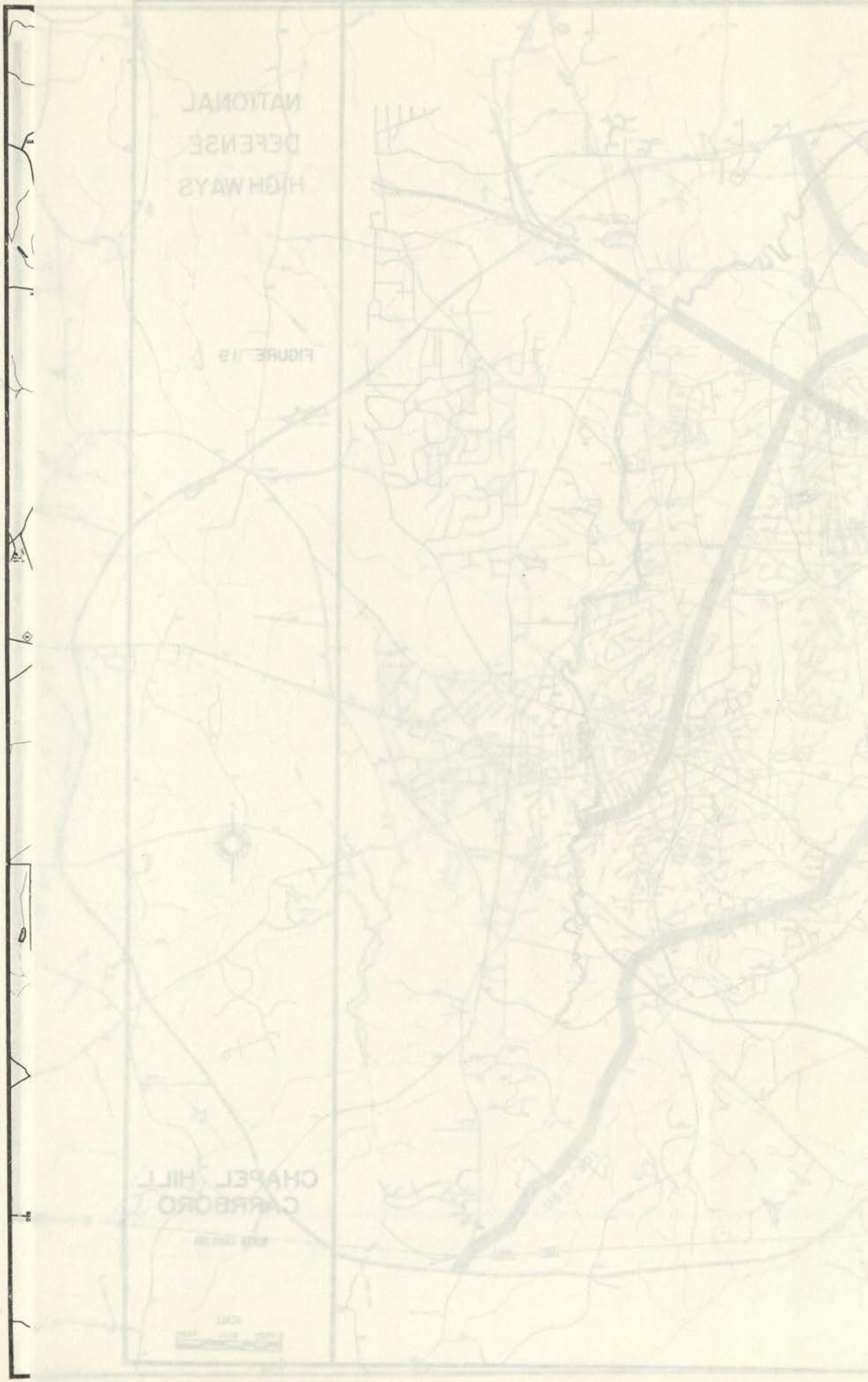
The layout of the major street system will also have an effect on air quality. A street system that will provide easy and direct movement between all sections of the city will reduce travel time and distances, subsequently reducing pollutant emissions.

Comparison of the alternative thoroughfare plans was made according to guidelines listed in Compilation of Air Pollutant Emission Factors, (Ap-42)(second edition), prepared by the Environmental Protection Agency. Under procedures in this manual air emission factors were calculated for different calendar years, different average speeds, and different pollutants. These factors were multiplied with the vehicle miles of travel (VMT) per speed increment to give total pounds of pollutants. The results are given in Table 19.

TABLE 19

Air Quality Analysis of Alternative Thoroughfare Plans

Year	Plan	VMT	Pounds of Emissions		
			Carbon Monoxide	Oxides of Nitrogen	Hydrocarbons
1995	A	1,258,762	6979	2872	1507
1995	B	1,250,240	6930	2876	1501
1995	C	1,279,841	7138	2900	1545
1995	D	1,243,668	7042	2817	1519



Environmental Effects

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sed in motor vehicles causes approximately
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duce emission.

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ne amount of pollutants added to the atmos-
t emissions are reduced whenever traffic is
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driving conditions. These reduction of pollu-
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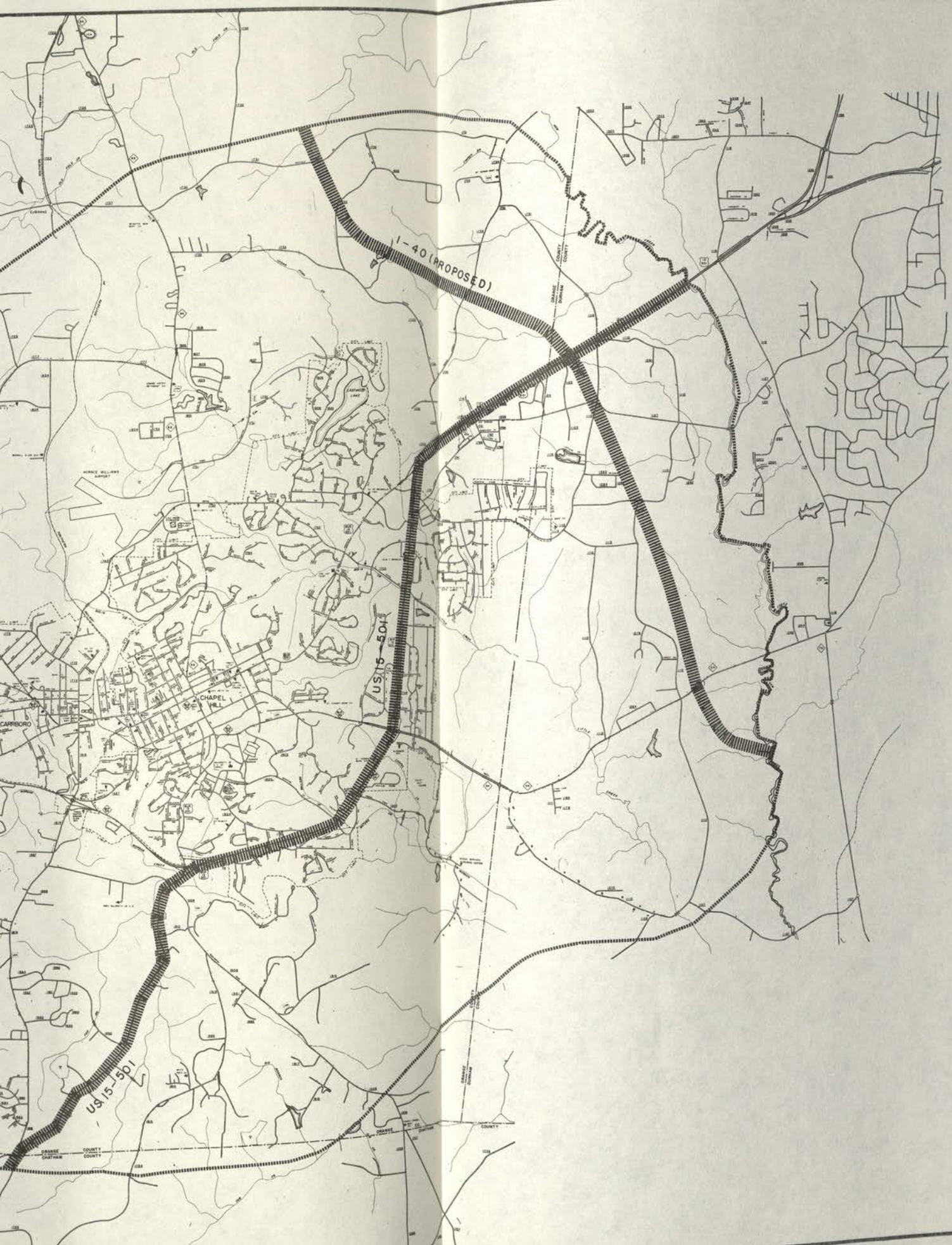
,279,841	7138	2900	1545
,243,668	7042	2817	1519



NATIONAL DEFENSE HIGHWAYS

FIGURE 19

N

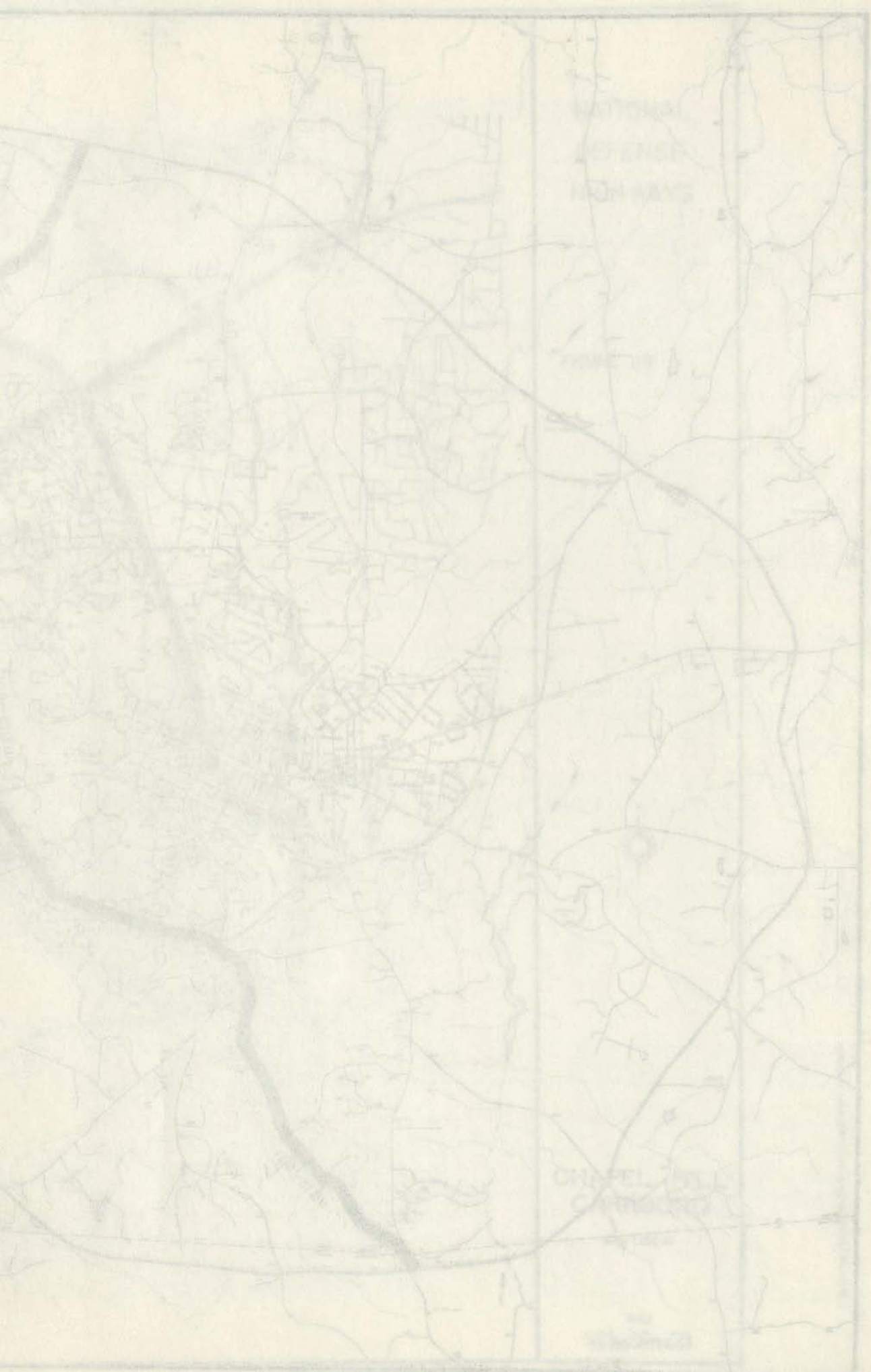
S

CHAPEL HILL CARRBORO

NORTH CAROLINA

SCALE

0 FEET 2000 4000



EFFECT OF CONGESTION ON AUTOMOBILE EMMISSIONS

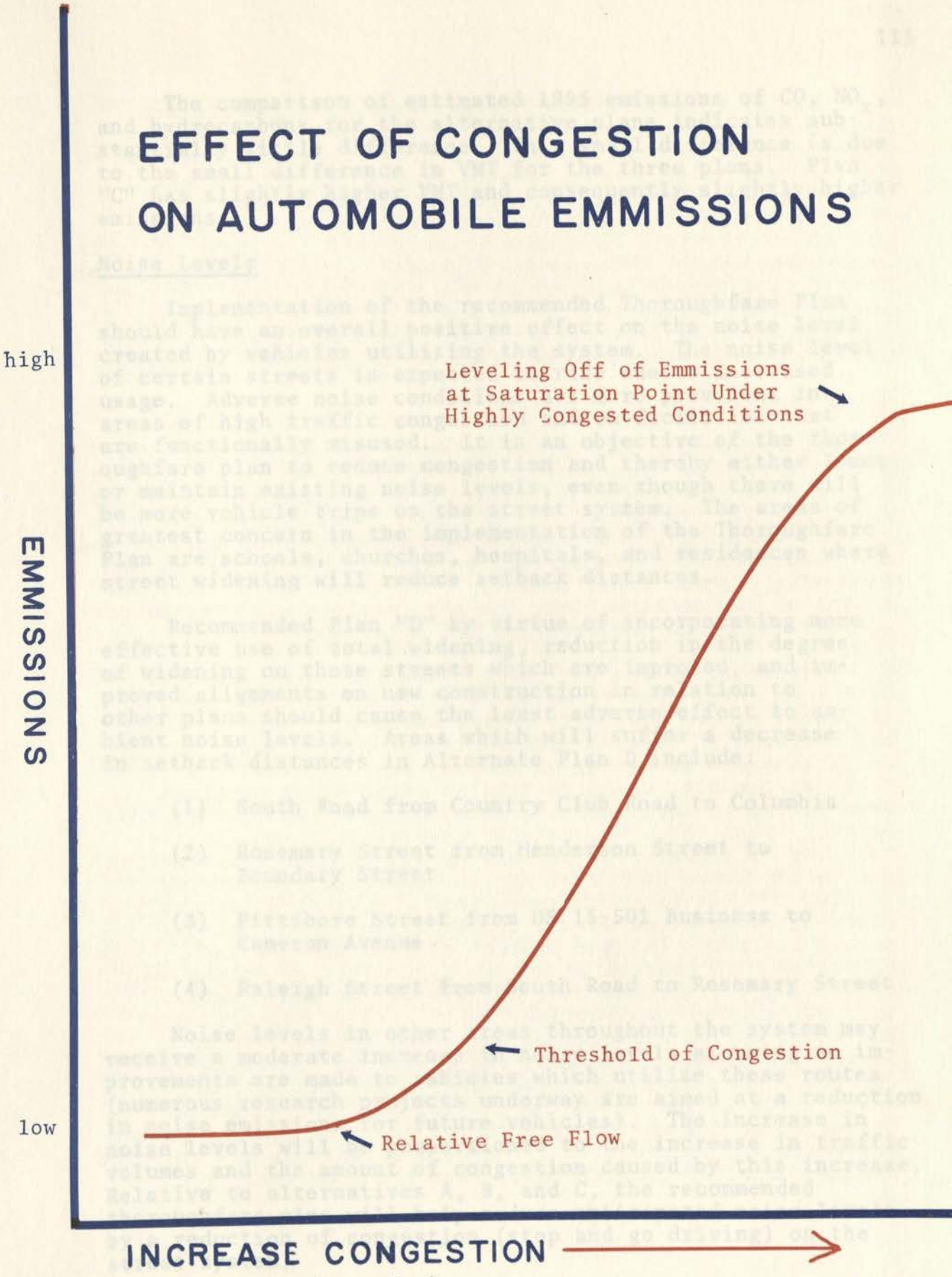
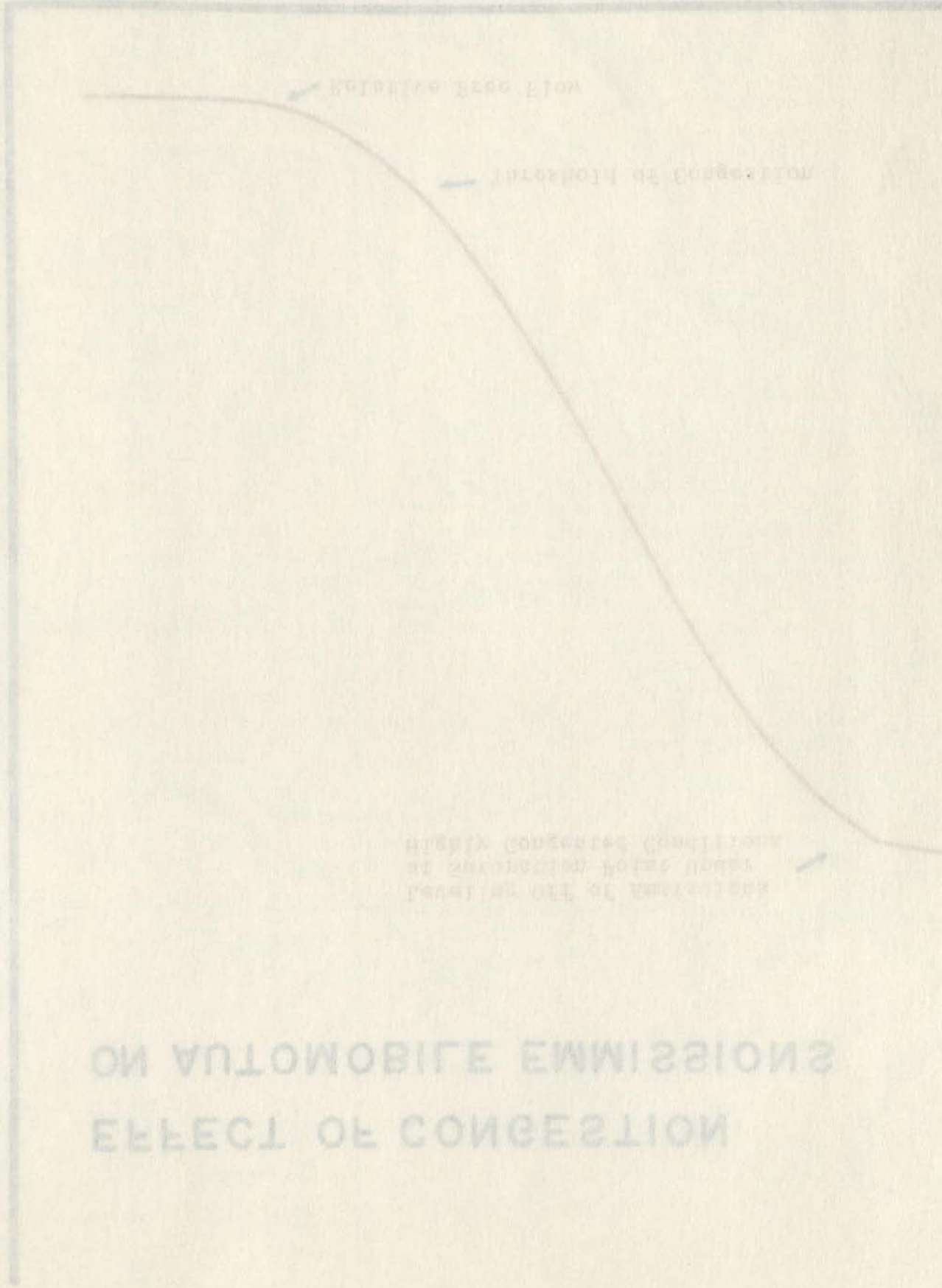


Figure 2


INCREASE CONGESTION
EMMISSIONS

The comparison of estimated 1995 emissions of CO, NO_x, and hydrocarbons for the alternative plans indicates substantially little difference. This small difference is due to the small difference in VMT for the three plans. Plan "C" has slightly higher VMT and consequently slightly higher emissions.

Noise Levels

Implementation of the recommended Thoroughfare Plan should have an overall positive effect on the noise level created by vehicles utilizing the system. The noise level of certain streets is expected to rise due to increased usage. Adverse noise conditions are more prevalent in areas of high traffic congestion and on facilities that are functionally misused. It is an objective of the thoroughfare plan to reduce congestion and thereby either lower or maintain existing noise levels, even though there will be more vehicle trips on the street system. The areas of greatest concern in the implementation of the Thoroughfare Plan are schools, churches, hospitals, and residences where street widening will reduce setback distances.

Recommended Plan "D" by virtue of incorporating more effective use of total widening, reduction in the degree of widening on those streets which are improved, and improved alignments on new construction in relation to other plans should cause the least adverse effect to ambient noise levels. Areas which will suffer a decrease in setback distances in Alternate Plan D include:

(1) South Road from Country Club Road to Columbia

(2) Rosemary Street from Henderson Street to Boundary Street

(3) Pittsboro Street from US 15-501 Business to Cameron Avenue

(4) Raleigh Street from South Road to Rosemary Street

Noise levels in other areas throughout the system may receive a moderate increase in noise levels assuming no improvements are made to vehicles which utilize these routes (numerous research projects underway are aimed at a reduction in noise emissions for future vehicles). The increase in noise levels will be proportioned to the increase in traffic volumes and the amount of congestion caused by this increase. Relative to alternatives A, B, and C, the recommended thoroughfare plan will help reduce anticipated noise levels by a reduction of congestion (stop and go driving) on the street system.

During todays highway design process, engineers are taking into consideration noise levels created by highway improvements. Recent research is providing techniques to predict the noise levels created by highway improvements and offer measures such as elevating or depressing the roadway, providing different roadway surfaces, and installing acoustical barriers to reduce noise levels. Highway projects undertaken by the Division of Highways, (NCDOT), now have noise predition analyses made during the planning stage. By comparing these noise predictions with current noise standards, the engineer can forecast possible areas of excessive noise pollution and take adequate steps to reduce their occurence.

Water Quality and Conservation

Water quality is a prime asset of all cities and every effort should be made during highway construction as well as during other construction to adhere to recommended guidelines to insure the prevention of pollution. Guidelines have been issued outlining procedures for maintaining water quality and the reduction of possible soil erosion occurring during and following highway construction. Obviously, the greater the extent of new construction, the more serious will be the problems relating to conservation and water quality.

Alternative Plan "A" should have the least possible affect on water quality owing to the fact that no new construction or new alignment is recommended. However, widening included in Plan "A" could create adverse water quality conditions due to having no control over the existing vertical alignments, which results in engineering problems when trying to implement the water quality controls listed below. Plans "B", "C", and "D" however will require the crossing of a number of streams by new highway construction. Due to the large number of stream crossings encountered by Plan "D", it is recommended that stringent water quality controls be enforced during construction. The controls should include: (1) the control of soil erosion and siltation, (2) control of waste disposal areas during construction, (3) the entering of live or impounded waters only within the construction limits, (4) no deposition of any construction material or pollution agents such as fuels, lubricants, bitumens, and sewage in traversed waters, (5) the proper drainage of all borrow pit and ditches, and (6) the inclusion in the project plan for adequate drainage control on the constructed facility and for waters traversed by the project. If adequate controls are enforced during and after construction, then the good quality of

the area's water supply will be assured.

Aesthetics

It is a highway designer's desire to provide a facility which is adequate, safe, and compatible with both the natural and man-made environment. The improvements offered by each of the alternative plans, especially Plan "C" will offer certain improvements over the existing conditions on several of the streets in the urban area. The recommended improvements will in some cases replace unsightly shoulder sections with broken pavement edges and open ditches with aesthetically more pleasing curb and gutter sections.

On some of the streets where widening is recommended, it will be necessary to disturb and/or remove some portions of residential lawns and some trees which line many of the widened streets. Sections of the recommended new streets, especially the Outer Loop and I-40 Bypass, traverse rural wooded areas. In order to retain the natural beauty of these areas, great care should be taken during planning and construction to maintain the scenic beauty.

Modern landscape methods should be used to make the highway improvements compatible with the surrounding environment either rural or urban. Such methods include flatter and rounder slopes, grassed berms and slopes, planting of trees and shrubbery at strategic locations (especially in disturbed urban areas), and the seeding of all disturbed earth areas with a grass cover.

Natural and Historic Landmarks

The Federal Government has recently issued guidelines requiring that all State Highway Departments make special efforts to preserve public parks, recreation areas, and historic sites. Such lands are not to be used for highway purposes unless there is no feasible alternative. The Federal Highway Administration has interpreted these guidelines as not only protecting historic sites but also protecting any setting or surrounding areas that might be adversely affected by a highway project. In all the alternate thoroughfare plans, due care would be taken in all construction projects to see that all historic sites and natural settings were preserved.

The following historic sites either in or near the planning area are listed in the State Plan for Historic Preservation Interim Site Inventory; or by the Chapel Hill Historic Society.

(1) William Horn Battle Home (Seneac)
(2) O. J. Brockwell Home
(3) Chapel of the Cross Episcopal Church
(4) Gimghoul Castle
(5) Archibald Henderson House
(6) Hexagon House (Horace Williams House)
(7) Hooper-Kyser House
(8) McDade House
(9) President's House
(10) Puckett-Robert House Home
(11) University of North Carolina (includes some of the oldest university buildings in the nation)
(12) Samuel F. Phillips Law Office
(13) Martin-Dey House
(14) Olmsted-Phillips-Presbyterian Manse
(15) James Lee Love House
(16) The Old Tavern
(17) Carrboro Railroad Depot
(18) Carrboro Cemetery
(19) Alberta Mill
(20) Old Mill (Steam powered grist mill built in Carrboro in 1916)
(21) Lloyd-Wiley House
(22) "Hoot" Patterson House
(23) Gattis-Allen House
(24) Wilson-Maurice House
(25) The Carolina Inn
(26) Old Methodist Church
(27) Huskey House
(28) Mickle-Mangum-Smith House
(29) The Samuel Phillips House
(30) Spencer House
(31) Kennette House
(32) Battle Park
(33) Old Cemetery (Route 54 and Country Club Road)
(34) Strowd House
(35) The Macon Farm and Cemetery
(36) Collier Cobb House
(37) Gore-Hocutt House

Improvements proposed under Alternative Plan "D" do not adversely affect any of the above historic sites. However, under Plan "A" the do nothing alternative, extensive widening could destroy the character of certain sites.

Discussion of the Alternate Thoroughfare Plans Relative to Providing a Feasible, Economic, Safe, and Efficient Transportation System

Plan A - Existing Major Street System

Alternative Plan "A" is a "do nothing" concept. In this report a "do nothing" concept refers to no new location or relocation of transportation facilities. It should be noted that widening of existing streets according to the dictates of traffic congestion could be accomplished under the above definition. Obviously this concept does not present any adverse environmental effects which may be incured by implementation of proposed realignment provements. A further advantage of a "do nothing" policy is that little additional capital expenses are required.

There are however several disadvantatages to a "do nothing" policy with regard to transportation planning. These include:

(1) Naturally increasing traffic volumes which congest existing major streets.
(2) As major streets become congested, residential streets will be used more frequently by through traffic.
(3) Existing "bottleneck" situations will worsen.
(4) Economic, social, health, and safety standards will deteriorate.
(5) Increased air pollution and noise pollution induced by traffic congestion.
(6) Increase car user cost.
(7) Increased driving time.
(8) Increased driver and public frustration due to congestion.
(9) Additional expense of street maintainence due to misuse and overuse.

The "do nothing" concept, while an alternative, is not a viable alternative in transportation planning. It can only be a viable alternate where there is no population or employment growth, no increase in external travel, and no

increase in internal travel by the existing population; or where all increase in travel is directed to an alternative transportation mode.

Plan B - Existing Thoroughfare Plan

Plan "B" was the first attempt at planning improvements for the Chapel Hill-Carrboro area street system. As a starting point, Plan "B" was fairly sufficient. However, after a detailed study, several disadvantages to the plan were detected. These include: (1) the highest estimated dislocation of residential and commercial development of any plan, (2) proposal of facilities which would perform essentially the same functions, (3) proposal of facilities whose construction would cause adverse environmental effects.

Plan "B" did make progress in attempting to distribute traffic over the planning area. Although this plan would greatly aid traffic operations in the Chapel Hill-Carrboro area, it is severely hampered by the problems mentioned in the paragraph above. The estimated cost of Plan "B" is $34,000,000.

Plan C

Plan "C" is basically a refinement of Plan "B" and changes that it incorporates include several additions and deletions to the urban street system. These changes should provide better access to and through the planning area than do plans "A" or "B".

In concept, there is little difference between Plan "C" and Plan "D". Overall Plan "C" would offer a basically sound traffic network. The estimated cost of Plan "C" is $33,000,000.

Plan D - Recommended Thoroughfare Plan

Plan "D" as discussed in Chapter V provides the highest level of service and best dispersion of traffic. In addition to this, economic and safety benefits should be significant. From the standpoint of satisfying most of the deficiencies listed in the Goals and Objectives Survey, Plan "D" is most satisfactory. The estimated cost of this alternate is $30,862,000.

Under this plan, accident probability as well as noise and air pollution levels will be kept to a minimum because

of a lower level of congestion, one-way design, and direct routing of traffic.

From a combined engineering, planning, public desires, and economic standpoint, Plan "D" most nearly satisfies the goal of providing a safe, convenient and efficient transportation system for the Chapel Hill-Carrboro area.

VII. IMPLEMENTATION

There are several tools which are available for implementation of the thoroughfare plan. These tools include the following:

(1) State-Municipal Adoption of the Thoroughfare Plan
(2) Direct Construction
(3) Subdivision Control
(4) Official Street Map
(5) Zoning
(6) Urban Renewal
(7) Capital Improvements Program

State-Municipal Adoption of the Thoroughfare Plan

Chapter 136, Article 3A, Section 136-66.2 of the General Statutes of North Carolina provides that after development of a thoroughfare plan, the plan may be adopted by the governing body of the municipality and the Board of Transportation as the basis for future street and highway improvements. If mutually adopted, negotiations will begin to determine which of the existing and proposed thoroughfares will be a Board of Transportation responsibility and which will be a municipal responsibility. Facilities which are designated as State responsibility will be constructed and maintained by the Division of Highways, however, the municipality will share in the right of way costs with the municipality's share of the cost to be determined at time of construction. The 1965 mutually adopted thoroughfare plan (Alternate "B") will continue to serve Chapel Hill, Carrboro, and environs until a mutually satisfactory revision can be developed and subsequently adopted.

Subdivision Control

A subdivision ordinance requires that every subdivider submit to the City Planning Board a plot of his proposed subdivision. Certain standards must be met by the developer

before he can be issued a building permit to construct his development. Through this process, it is possible to reserve or protect the necessary right of ways for projected streets which are a part of the thoroughfare plan and to require street construction in accordance with the plan.

Facilities which could be implemented by subdivision control include:

(1) Umstead Drive and Main Street Connector
(2) NC 54 Bypass Extension
(3) SR 1843 Extension
(4) Bayberry Drive Extension
(5) Sections of the Outer Loop from Smith Level Road to SR 1777
(6) Piney Mountain Road Extension

Official Street Map

A municipality may, through special enabling legislation, adopt an official street map which indicates both existing and future street lines. No new construction or reconstruction of structures would be permitted within the designated future street lines. This would over a period of time, reduce the cost of additional right of way along densely developed thoroughfares which will require widening at some future date.

Facilities in the planning area which could benefit from enactment of a street map with specified setback distances are:

(1) US 15-501 Business
(2) Airport Road
(3) Main Street
(4) Greensboro Street

Zoning

A zoning ordinance can be beneficial to thoroughfare planning in that planned locations of various land uses and planned densities of dwelling units can be realized. This provides a degree of stability on which to make future traffic projections and to plan streets and highways.

Other benefits of a good zoning ordinance are: (1) The establishment of standards of development which will aid traffic operations on major thoroughfares; (2) the minimization of strip commercial development which creates traffic friction and increases the traffic accident potential; and (3) the requirement for provision of off-street parking by new developers with the purpose of eventual prohibition of all curb parking on major thoroughfares.

The existing street system apparently has not experienced a decreased traffic carrying capacity due to strip development. However, zoning measures should be invoked to control development along the major traffic carrying thoroughfares including sections of the Outer Loop, US 15-501, and NC 54.

Urban Renewal

Urban renewal is the term used to describe the removal of blight in cities. It is one of the few tools available for correcting basic mistakes in the existing street pattern.

This urban renewal is carried out under the framework of the New Housing Act of 1974 as amended. The basis for the process of Urban renewal is carried out under the Community Development Block Grants. Urban Renewal consists of a three-fold attack on blight. It calls for the conservation of good areas of the cities, rehabilitation of declining areas, and for clearance of slum areas so that they may be redeveloped to good standards. If a municipality meets certain requirements as to master plan, good codes and ordinances, and citizen participation, it may obtain assistance in such a program from the Federal Government with the Government paying three-fourths of the cost of the project."

Portions of Franklin Street Extension, Cameron Avenue Extension, Merritt Mill Road, and the connector between Umstead Drive and Main Street would be in an area where urban renewal funds could be used if available.

Levels of Implementation

In addition to the priority rating that has been mentioned

previously, it is desirable to establish levels of implementation when consideration is made of the availability of anticipated funds. Cognizance of this funding consideration led to the establishment of the following categories:

Critical - greatly needed and can be funded

(1) McCauley Street and McCauley Street Extension
(2) NC 54 East
(3) Airport Road
(4) NC 54 and US 15-501 Bypass
(5) Pittsboro-Columbia Street one-way pair
(6) Rosemany-Franklin Street one-way pair
(7) Main Street

Very Desirable - needed and can be funded

(1) US 15-501 Business North and South
(2) Columbia Street
(3) Greensboro Street
(4) Jones Ferry Road
(5) US 15-501 South
(6) Park Place and Boundary Street Connector
(7) South Road
(8) Ephesus Church Road and Connector to Willow Drive

Desirable - needed but funding does not appear to be available

(1) Merritt Mill Road
(2) US 15-501 North
(3) Estes Drive
(4) SR 1843 Extension
(5) SR 1919
(6) North Greensboro Street
(7) Manning Drive
(8) Ridge Road
(9) Raleigh Street
(10) Hillsborough Street

Capital Improvements Program

One of the tools which makes it easier to build a planned

thoroughfare system is a capital improvement program. This is a long range plan for the spending of money on street improvements within the bounds of projected revenues. Municipal funds should be available for construction of street improvements which are a municipal responsibility, right of way cost sharing on facilities designated a Division of Highways responsibility, and advance purchase of right of way where such action is required.

The section of the capital improvements program which deals with the thoroughfare plan requires a fairly detailed knowledge of the costs of various projects. Therefore, the cost estimates included in this report should be used with caution since they are preliminary estimates based on general statewide averages of construction costs and "windshield" estimates of right of way costs.

Detailing of the Plan

For the proper administration of subdivision regulations, it is desirable that a plan be detailed to the extent that preliminary designs of proposed facilities are delineated on topographic mapping of a horizontal scale of 1" = 100' or 1" = 200'. Such preliminary design would more fully indicate the nature of proposed improvements, right of way needs, and the effect of proposed improvements on adjacent properties. These preliminary designs have been completed as part of this thoroughfare planning study.

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APPENDIX A

TABLE 1

THOROUGHFARE PLAN STREET TABULATIONS AND RECOMMENDATIONS

FACILITY AND SECTION	LENGTH (MILES)	EXISTING CROSS SECTION ROADWAY (FEET)	EXISTING CROSS SECTION R/W (FEET)	PRESENT CAPACITY	TRAFFIC VOLUMES 1971	TRAFFIC VOLUMES 1995	RECOMMENDED 1995 CROSS SECTIONS ROADWAY	RECOMMENDED 1995 CROSS SECTIONS R/W	PRIORITY	PROPOSED ULTIMATE CROSS SECTIONS ROADWAY	PROPOSED ULTIMATE CROSS SECTIONS R/W
Airport Road (See NC 86)											
Bayberry Drive											
Farrington Rd. - Greybluff Dr.	0.8	20	60	5,300	1,000	3,600	Adequate	Adequate	Long Range	M	60
Greybluff Dr. - Outer Loop	1.8	-	-	-	-	3,600	-	-			
Boundary Street											
Country Club Rd. - Senlac Rd.	0.1	20	60	5,300	4,000	7,020	Adequate	Adequate			
Connector from near Senlac Rd. Park Place	0.1	-	-	-	-	7,000	H	60	2		
Cameron Avenue											
Boundary St. - Merritt Mill Rd.	1.0	24-48	-	5,300	8,000	19,200	Adequate	Adequate	Long Range	D	70
Merritt Mill Rd. - Greensboro St.	0.5	-	-	-	-	10,350	-	-			
Columbia Street											
Pittsboro St. - NC 54 Bus.	0.3	38	60	12,000	12,250	24,600	Adequate	Adequate	3		
NC 54 Bus. - Cameron Ave.	0.2	29	60	6,700	13,060	20,600	I	Adequate			
Cameron Ave. - Franklin St.	0.2	51	60	20,100	14,300	21,800	Adequate	Adequate			
Country Club Road											
Boundary St. - South Rd.	0.4	35	Var. 50-60	6,700	7,560	6,000	Adequate	Adequate			
Ephesus Church Road											
SR 1127 - SR 1114	0.6	18	60	4,700	3,100	4,900	Adequate	Adequate			
SR 1114 - Bambury Ln.	0.7	20	60	5,300	5,000	14,000	D	80	3		
Connector to Willow Dr. at Nut St.	0.3	-	-	-	-	13,800	D	80	3		
Estes Drive											
NC 86 - Caswell Rd.	0.7	20	60	5,300	5,500	12,200	D	80	3		
Caswell Rd. - Burlage Cir.	0.4	35	60	6,700	7,300	11,200	D	80	3		
Burlage Cir. - US 15-501 Bus.	0.2	Var. 20-40	60	5,300	7,300	11,800	D	80	3		
US 15-501 Bus. - US 15-501 Bypass	0.6	64	100	6,700	7,200	11,800	Adequate	Adequate			
US 15-501 Bypass - End of Estes	0.2	20	60	4,700	540	240	Adequate	Adequate	Long Range	H	Adequate
End of Estes - Outer Loop	0.8	-	-	-	-	240	-	-	Long Range	H	60
Finley Golf Course Rd. (See SR 1900)											
Franklin Street											
US 15-501 Byp. - Columbia St.		(See US 15-501 Business)									
Columbia St. - Main St.		(See NC 54 Business)									
Merritt Mill Rd. - Greensboro St.	0.4	-	-	-	-	18,100	I	60	2		
Greensboro St. - Bim St.	0.3	-	-	-	-	6,100	H	60	2		
Greensboro Street											
NC 54 Bypass - Main St.	0.6	20	60	5,300	5,200	24,600	C	90	2		
Hillsborough Road (Carrboro)											
Old Greensboro Rd. - Main St.	0.7	18	60	6,700	1,500	13,000	Adequate	Adequate			
Hillsborough St. (Chapel Hill)											
Rosemary St. - Airport Rd.	0.7	Var. 24-36	Var. 40-60	6,700	3,900	12,250	D	80	4		
Main Street (Carrboro)											
Rosemary St. - Greensboro St.	0.5	Var. 33-36	60	6,700	14,550	19,600	I	Adequate	2		

Merritt Mill Road											
Greensboro St. - Franklin St.	1.0	Var. 18-20	Var. 45-90	4,700	4,900	15,800	D	80	2		
NC 54 Business											
US 15-501 Byp. - Greenwood Rd.	0.3	72	150	14,800	12,000	31,850	Adequate	Adequate			
Greenwood Rd. - Country Club Rd.	0.6	51	100	14,800	12,300	32,300	B	Adequate	2		
Country Club Rd. - Columbia St.	0.6	39	60	6,700	11,000	34,400	D	90	2		
McCauley St. - Franklin St. (See US 15-501 Business)											
Columbia St. - Merritt Mill Rd.	0.6	57	60	20,100	15,400	18,000	Adequate	Adequate			
Merritt Mill Rd. - Rosemary St.	0.1	33	60	6,700	9,800	15,200	Adequate	Adequate			
Rosemary St. - Hillsborough Rd. (See Main Street)											
Hillsborough Rd. - NC 54 Byp.	0.9	Var. 18-19	60	4,700	2,750	6,900	Adequate	Adequate			
NC 54 and NC 54 Bypass											
Cordon Line (East) - SR 1110	2.4	20	60	5,300	7,000	16,200	A	250	1		
SR 1110 - East City Limits of Chapel Hill	0.6	48	185	14,800	6,450	21,900	Adequate	Adequate			
East City Limits of Chapel Hill - US 15-501 Byp.	0.6	Var. 72-76	150	14,800	10,300	27,200	Adequate	Adequate			
NC 54 Bus. - US 15-501 Bus. (See US 15-501 Bypass)											
US 15-501 Bus. - 0.3 Mile West	0.3	Var. 36-48	150	14,800	7,040	17,600	A	Adequate	1		
0.3 Mi. West - Jones Ferry Rd.	1.5	24	150	6,700	6,600	17,550	A	Adequate	1		
Jones Ferry Rd. - NC 54 Bus.	0.9	24	150	6,700	2,600	9,150	Adequate	Adequate			
NC 54 Bus. - Cordon Line (West)	2.3	24	60	4,700	4,200	8,300	Adequate	Adequate			
NC 54 Bypass Extension (Carrboro)											
NC 54 - SR 1009	0.7	20 (Soil)	60	3,000	300	2,100	H	Adequate	4		
SR 1009 - Proposed Extension SR 1843	1.0	-	-	-	-	1,150	G	70	4		
NC 86 (Airport Road)											
US 15-501 Bus. - North St.	0.2	62	100	14,800	14,300	17,500	Adequate	Adequate			
North St. - Barclay Rd.	1.1	64	100	14,800	12,560	25,500	Adequate	Adequate			
Barclay Rd. - SR 1777	1.3	52	100	14,800	7,850	27,500	B	Adequate	1		
SR 1777 - Cordon Line (North)	1.4	18	60	4,700	4,450	12,400	D	80	1		
Old Greensboro Rd. (SR 1772)											
Hillsborough Rd. - Pleasant Dr.	1.0	20	60	5,300	2,700	4,500	Adequate	Adequate			
Pleasant Dr. - Main St.	0.4	20	60	5,700	3,000	23,100	D	80	4		
Old Pittsboro Road											
Greensboro St. - 0.3 Mile North	0.3	20	60	4,700	2,000	8,100	H	Adequate	4		
0.3 Mile North - Main St.	0.2	-	-	-	-	12,200	-	60	Long Range	H	60
Outer Loop											
SR 1939 - SR 1008	2.5	-	-	-	-	7,900	-	-	Long Range	G	70
SR 1008 - End of SR 1916	0.9	Var. 20-Soil	60	5,300	200	6,600	Adequate	Adequate	Long Range	G	70
SR 1916 - NC 54	1.9	-	-	-	-	8,000	-	-	Long Range	G	70
NC 54 - Ephesus Church Rd.	2.1	-	-	-	-	8,100	-	-	Long Range	H	70
Ephesus Church Rd. - SR 1786	0.6	-	-	-	-	12,400	-	-	Long Range	D	80
SR 1786 - End of SR 1741	0.4	Var. 20-Soil	60	5,000	300	7,300	Adequate	Adequate	Long Range	D	80
SR 1741 - Weaver Dairy Rd.	0.4	-	-	-	-	7,300	-	-	Long Range	D	80
Weaver Dairy Rd. - NC 86	2.3	20	60	5,300	300	13,000	Adequate	Adequate	Long Range	D	80
NC 86 - SR 1834	1.3	-	-	-	-	3,000	-	-	Long Range	G	70
Park Place											
Franklin St. - Connector to Boundary St.	0.1	20	60	5,300	2,800	7,000	Adequate	Adequate			
Piney Mountain Road (SR 1751)											
NC 86 - SR 1837	1.1	20	60	4,700	500	4,300	Adequate	Adequate			
SR 1837 - Kenmore Dr.	0.5	-	-	-	-	4,300	H	60	3		
Kenmore Dr. - Weaver Dairy Rd.	0.7	24	60	5,300	400	4,300	Adequate	Adequate			
Pittsboro Street											
Pittsboro Rd. - Cameron Ave.	0.4	30	50	5,300	4,960	24,600	I	60	1		
Cameron Ave. - Pritchard St.	0.3	-	-	-	-	11,500	I	60	1		
Connector to Columbia St.	0.1	-	-	-	-	19,300	I	60	1		
Raleigh Street											
South Road - Cameron Ave.	0.2	24	50	6,700	7,400	12,500	I(4-lanes)	Adequate	4		
Cameron Ave. - Rosemary St.	0.2	Var. 24-32	Var. 40-60	6,700	8,600	20,000	I(4-lanes)	Adequate	4		
Ridge Road (SR 1903)											
South Rd. - Manning Dr.	0.6	18	60	4,700	4,500	5,600	E	Adequate	4		
Rosemary St.											
NC 54 Bus. - Henderson St.	0.8	40	45-50	5,300	7,430	22,900	Adequate	Adequate			
Henderson St. - Boundary St.	0.4	24	45	4,700	3,100	18,000	I	60	2		
Connector to Franklin St. at Park Place	0.1	-	-	-	-	16,700	I	60	2		
SR 1005											
Cordon Line (West) - SR 1942	2.1	20	60	5,300	1,450	5,350	Adequate	Adequate			
SR 1942 - Main St.	1.5	20	60	5,300	3,000	8,350	Adequate	Adequate	Long Range	H	Adequate
SR 1006											
US 15-501 - SR 1915	0.6	20	60	5,300	3,270	7,700	Adequate	Adequate	Long Range	H	Adequate
SR 1915 - Cordon Line	1.9	20	60	5,300	1,920	4,000	Adequate	Adequate			
SR 1009											
Hillsborough Rd. - Cordon Line	2.1	18	60	6,700	2,800	4,100	Adequate	Adequate			
SR 1104											
SR 1009 - Cordon Line	0.1	20	60	5,300	1,270	2,200	Adequate	Adequate			
SR 1109											
SR 1110 - Cordon Line	0.3	18	60	4,700	400	900	Adequate	Adequate			
SR 1110											
NC 54 - NC 54	3.1	18	60	4,700	850	2,100	Adequate	Adequate			
SR 1127											
SR 1113 - Cordon Line (East)	1.1	18	60	4,700	1,100	1,900	Adequate	Adequate			
SR 1724											
SR 1915 - Cordon Line (South)	0.2	20	60	5,300	220	400	Adequate	Adequate			
SR 1734											
US 15-501 - Outer Loop	0.6	18	60	4,700	1,130	10,050	Adequate	Adequate	Long Range	H	Adequate
Outer Loop - Cordon Line	2.1	18	60	4,700	1,130	4,050	Adequate	Adequate			
SR 1777											
NC 86 - SR 1009	3.3	18	60	4,700	1,700	2,500	Adequate	Adequate			
SR 1780											
Hillcrest Ave. - NC 86	1.4	20	60	5,300	3,500	9,000	Adequate	Adequate	Long Range	H	Adequate
SR 1834											
SR 1777 - SR 1843	0.3	20	60	4,700	400	5,050	Adequate	Adequate			
SR 1838											
SR 1113 - SR 1741	1.1	18	60	4,700	1,000	900	Adequate	Adequate			
SR 1843											
SR 1834 - End of SR 1843	0.3	18	60	4,700	400	3,050	Adequate	Adequate			
SR 1843 - SR 1772 at Pleasant Dr.	1.7	-	-	-	-	6,800	G	70	3		
SR 1915											
SR 1006 - SR 1724	2.0	20	60	5,300	220	3,000	Adequate	Adequate			
SR 1939											
SR 1919 - Cordon Line (South)	1.8	20	60	5,300	260	1,400	Adequate	Adequate			
SR 1942											
SR 1005 - Cordon Line	1.8	18	60	5,300	840	4,300	Adequate	Adequate			
Smith Level Road (SR 1919)											
US 15-501 - SR 1939	1.7	20	60	5,300	5,500	6,400	G	70	3		
SR 1939 - NC 54 Bypass	1.4	20	60	5,300	5,600	16,400	D	80	3		
South Road (See NC 54 Business)											
Umstead Drive											
NC 86 - SR 1780	1.0	Var. 20-50	60	4,700	700	900	Adequate	Adequate			
Umstead Drive - Main St. Connector											
Umstead Drive - Main St.	0.8	-	-	-	-	2,800	H	60	4		
US 15-501 Business											
US 15-501 Byp. - Pittsboro St.	0.8	Var. 24-44	60	6,700	9,400	14,350	D	80	2		
Pittsboro St. - Franklin St. (See Columbia St.)											
Columbia St. - Park Pl.	0.8	Var. 50-62	60	20,100	13,360	16,600	Adequate	Adequate			
Park Pl. - Howell Ln.	0.6	Var. 44-48	60	13,800	13,950	39,200	B	90	2		
Howell Ln. - Milton Ave.	1.2	64	100	14,800	18,600	36,100	Adequate	Adequate			
Milton Ave. - US 15-501 Byp.	0.3	Var. 44-64	200	14,800	18,400	36,100	B	Adequate	2		
US 15-501 and US 15-501 Byp.											
Cordon Line (South) - NC 54 Byp	3.0	24	60	6,200	6,200	12,200	A	250	2		
NC 54 Byp. - Winter Rd.	0.3	Var. 22-54	200	12,000	7,910	16,800	A	Adequate	1		
Winter Rd. - SR 1814	3.6	22	200	5,700	13,900	33,300	A	Adequate	1		
SR 1814 - US 15-501 Bus.	0.2	Var. 22-46	200	5,700	12,850	29,700	D	Adequate	1		
US 15-501 - US 15-501 Bus.	0.2	Var. 22-46	200	17,700	20,500	44,600	A	Adequate	4		

APPENDIX A
TABLE 2

HIGH FREQUENCY ACCIDENT LOCATION			
STREET ON WHICH ACCIDENT OCCURRED	REFERENCE STREET	TOTAL ACCIDENTS	SEVERITY INDEX
NC 54	US 15	6	1.80
NC 54	Columbia	7	1.00
US 15	Willow	7	1.69
Boundary	Franklin	7	2.46
Cameron	Columbia	15	1.37
Cameron	Pittsboro	7	1.34
Church	Franklin	9	2.13
Columbia	NC 54	6	1.00
Columbia	Cameron	10	1.24
Columbia	Franklin	22	1.55
Columbia	McCauley	6	1.80
Columbia	Rosemary	10	1.48
Estes	Franklin	7	2.03
Franklin	Boundary	6	2.70
Franklin	Church	9	2.13
Franklin	Columbia	14	1.51
Franklin	Estes	5	1.96
Franklin	Henderson	17	1.14
Franklin	Hillsboro	5	1.96
Henderson	Rosemary	9	1.00
Rosemary	Columbia	5	1.48
Rosemary	Henderson	6	1.00

APPENDIX A
TABLE 2

HIGH FREQUENCY ACCIDENT LOCATION

STREET ON WHICH ACCIDENT OCCURRED	REFERENCE STREET	TOTAL ACCIDENTS	SEVERITY INDEX
NC 54	US 15	6	3.80
NC 54	Columbia	7	1.00
US 15	Willow	7	1.66
Boundary	Franklin	7	2.46
Cameron	Columbia	15	1.37
Cameron	Pittsboro	7	1.34
Church	Franklin	6	2.15
Columbia	NC 54	6	1.00
Columbia	Cameron	10	1.24
Columbia	Franklin	22	1.55
Columbia	McCauley	9	1.80
Columbia	Rosemary	10	1.46
Estes	Franklin	7	2.05
Franklin	Boundary	6	2.70
Franklin	Church	9	3.13
Franklin	Columbia	14	1.51
Franklin	Estes	5	1.96
Franklin	Henderson	12	1.14
Franklin	Pittsboro	5	1.96
Henderson	Rosemary	6	1.00
Rosemary	Columbia	5	1.48
	Henderson	6	1.00

APPENDIX A
TABLE 3

MULTIPLE REGRESSION ANALYSIS STATISTICAL DATA				
VARIABLE	COEFFICIENT	STANDARD ERROR OF COEFFICIENT	T VALUE	BETA COEFFICIENT
X_1	2.74	0.55	5.00	0.23
X_2	9.54	0.55	17.20	0.78
X_3	0.28	0.08	3.57	0.10
F Level		12.74		
Standard Error of Y		99.11		
Constant		33.35		

X_1 - Retail and Wholesale Employment

X_2 - Highway Retail

X_3 - Dwelling Units

ZONE	DWELLING UNIT RATING WHITE AAW	AW	BAW	NON-WHITE AANW	ANW	BANW	DWELLING U SUMMARY WHITE	N-W
1	7	5	-	-	-	-	12	
2	81	24	1	-	-	-	106	
3	-	-	-	-	-	-	-	
4	-	-	-	-	-	-	-	
5	59	23	27	41	17	10	109	
6	-	-	-	41	16	13	-	
7	-	-	-	70	54	30	-	
8	-	12	-	66	32	47	12	
9	419	82	2	26	-	-	503	
10	427	3	2	-	-	-	432	
11	-	-	-	36	14	15	-	
12	-	-	-	9	16	6	-	
13	107	63	-	-	-	-	170	
14	306	133	-	-	-	-	439	
15	-	-	-	-	-	-	-	
16	-	-	-	-	-	-	-	
17	2	1	-	-	-	-	3	
18	43	-	-	-	-	-	43	
19	165	10	1	-	-	-	176	
20	38	2	-	-	-	-	40	
21	258	9	-	-	-	-	267	
22	114	-	-	-	-	-	114	
23	73	-	-	-	-	-	73	
24	-	-	-	-	-	-	-	
25	196	22	-	-	-	-	218	
26	25	-	-	-	-	-	25	
27	574	-	-	-	-	-	574	
28	1	-	-	-	-	-	1	
29	-	-	-	-	-	-	-	
30	-	-	-	-	-	-	-	
31	17	15	1	2	7	2	33	
32	22	2	1	-	-	-	25	
33	53	7	1	-	-	-	61	
34	7	1	2	-	-	-	10	
35	13	7	4	-	-	-	24	
36	83	15	4	-	-	-	102	
37	57	-	-	-	-	-	57	
38	277	-	-	-	-	-	277	
39	44	12	5	-	-	-	61	
40	69	13	1	-	-	-	83	
41	5	5	-	-	-	-	10	
42	35	9	1	-	-	-	45	
43	16	11	2	-	-	-	29	
44	21	7	-	-	-	-	28	
45	13	2	-	-	-	-	15	
46	43	-	-	-	-	-	43	
47	13	4	-	-	-	-	17	
48	322	-	-	-	-	-	322	
49	465	-	-	-	-	-	465	
50	149	-	-	-	-	-	149	
51	148	-	-	-	-	-	148	
52	122	-	-	-	-	-	122	
53	108	-	-	-	-	-	108	
54	5	5	1	-	-	-	11	
55	18	23	1	-	-	-	42	
56	82	109	-	-	-	-	191	
57	26	6	6	-	-	-	38	
58	-	1	1	-	-	-	2	
59	66	-	-	-	-	-	66	
60	119	-	-	-	-	-	119	
61	41	-	-	-	-	-	41	
62	352	7	-	-	-	-	359	
63	-	-	-	-	-	-	-	
64	55	3	-	-	-	-	58	
65	17	45	3	20	17	3	65	
66	-	-	-	-	-	-	-	
67	40	19	3	-	-	-	62	
68	49	27	36	-	-	-	112	
69	53	12	2	-	-	-	67	
70	82	53	2	-	-	-	137	
71	10	10	1	1	5	7	21	
72	6	7	-	-	-	-	13	
73	225	44	2	65	21	6	271	
74	229	80	3	-	-	-	312	
75	260	129	21	-	-	-	410	
76	22	63	12	-	-	-	97	
77	268	45	5	-	1	1	318	
78	288	-	-	75	36	40	288	
79	28	10	10	-	-	-	48	
80	10	48	-	4	4	4	58	
81	5	6	1	-	1	-	12	
82	17	11	1	-	-	-	29	
83	211	15	2	-	-	-	228	
84	144	4	-	-	-	-	148	
85	2	2	-	-	-	-	4	
86	42	5	1	-	-	-	48	
87	67	1	-	-	-	-	68	
88	117	39	-	-	-	-	156	
89	49	1	-	-	-	-	50	
90	29	39	2	-	-	-	70	
91	19	7	-	-	-	-	26	
92	5	3	-	-	-	-	8	
TOTAL	8055	1378	171	456	241	184	9604	

ABOVE AVERAGE WHITE	AAW
AVERAGE WHITE	AW
BELOW AVERAGE WHITE	BAW
ABOVE AVERAGE NON-WHITE	AANW
AVERAGE NON-WHITE	ANW

[a]PERCENT INTERNAL TRIPS OF TOTAL TRIPS PRODU

[b]SECONDARY NHB TRIPS = 0.50 X EXTERNAL-INTER

[c]ZONE (X) NHB TRIPS = [ZONE (X) ATTRACTION F / [SUM ALL ATTR

[d]SEE APPENDIX A, TABLE 3 FOR MULTIPLE REGRES

APPENDIX B

TABLE 1

CHAPEL HILL-CARRBORO TRIP GENERATION AND TRIP PRODUCTION
FOR 1971 INTERNAL TRAFFIC

ONE DP.	DWELLING UNIT TRIPS: WHITE AAW	WHITE AW	WHITE BAW	NON-WHITE AANW	NON-WHITE ANW	NON-WHITE BANW	AUTO[A] TRIPS	TRUCK TRIPS[C]: NO. VEH.	GEN. RATE	TRUCK TRIPS	COMMERCIAL PASSENGER VEHICLES[E]: NO. VEH.	GEN. RATE	VEH. TRIPS	TAXI TRIPS[G]: NO. TAXIS	GEN. RATE	TAXI TRIPS	A + C + E + G TOTAL TRIPS BY ALL VEH. GAR. INSIDE	TOTAL TRIPS BY ALL VEH. GAR. INSIDE WITHOUT EXT.-INT.	INT.-INT. HBW TRIPS PRODUCED 18%	INT.-INT. OHB TRIPS PRODUCED 55%	INT.-INT. NHB TRIPS PRODUCED 27%	ATTRACTION FACTOR (REG. ANALYSIS)	TRI &
29	60	27	5	-	-	-	87	32	6.7	214	35	6.7	235	-	40.0	-	536	447	83	254	124	2784	
54	689	127	5	-	-	-	821	1	6.7	7	1	6.7	7	-	40.0	-	835	697	129	395	194	197	
-	-	-	-	-	-	-	-	18	6.7	121	5	6.7	34	-	40.0	-	155	129	24	73	36	571	
-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	40.0	-	-	-	-	-	-	5533	
07	502	122	132	303	107	19	1185	22	6.7	147	7	6.7	47	-	40.0	-	1379	1151	213	652	320	244	
53	-	-	-	303	101	25	425	40	6.7	268	58	6.7	389	17	40.0	680	1766	1474	273	835	410	1504	
54	-	-	-	518	340	57	915	1	6.7	7	-	6.7	-	-	40.0	-	922	770	143	436	214	77	
51	-	64	-	488	202	89	843	2	6.7	13	-	6.7	-	-	40.0	-	856	715	132	405	199	81	
02	3562	435	10	192	-	-	4199	6	6.7	40	8	6.7	54	-	40.0	-	4293	3583	665	2031	997	184	
37	3630	16	10	-	-	-	3556	3	6.7	20	2	6.7	13	-	40.0	-	3689	3079	571	1745	857	659	
34	-	-	-	266	88	29	383	2	6.7	13	-	6.7	-	-	40.0	-	396	331	61	188	92	71	
12	-	-	-	67	101	11	179	12	6.7	80	1	6.7	7	-	40.0	-	266	222	41	126	62	543	
08	910	334	-	-	-	-	1244	-	6.7	-	-	6.7	-	-	40.0	-	1244	1038	193	589	289	81	
53	2601	705	-	-	-	-	3306	-	6.7	-	-	6.7	-	-	40.0	-	3306	2760	512	1564	768	158	
-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	40.0	-	-	-	-	-	-	3057	
-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	40.0	-	-	-	-	-	-	599	
7	17	5	-	-	-	-	22	-	6.7	-	-	6.7	-	-	40.0	-	22	18	3	10	5	777	
03	366	-	-	-	-	-	366	-	6.7	-	-	6.7	-	-	40.0	-	366	306	57	173	85	46	
22	1403	53	5	-	-	-	1461	-	6.7	-	-	6.7	-	-	40.0	-	1461	1220	226	691	339	83	
96	323	11	-	-	-	-	334	-	6.7	-	-	6.7	-	-	40.0	-	334	279	52	158	77	45	
41	2193	48	-	-	-	-	2241	39	6.7	261	4	6.7	27	-	40.0	-	2529	2111	392	1196	587	424	
74	969	-	-	-	-	-	969	-	6.7	-	-	6.7	-	-	40.0	-	969	809	150	458	225	66	
75	621	-	-	-	-	-	621	-	6.7	-	1	6.7	7	-	40.0	-	628	524	97	297	146	54	
-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	40.0	-	-	-	-	-	-	655	
23	1666	117	-	-	-	-	1783	-	6.7	-	-	6.7	-	-	40.0	-	1783	1488	276	843	414	95	
60	213	-	-	-	-	-	213	-	6.7	-	2	6.7	13	-	40.0	-	226	188	35	107	52	40	
78	4879	-	-	-	-	-	4879	-	6.7	-	-	6.7	-	-	40.0	-	4879	4073	755	2308	1133	196	
2	9	-	-	-	-	-	9	-	6.7	-	-	6.7	-	-	40.0	-	9	8	1	4	2	34	
-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	40.0	-	-	-	-	-	-	33	
-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	40.0	-	-	-	-	-	-	33	
18	145	80	5	15	44	4	293	-	6.7	-	-	6.7	-	-	40.0	-	293	245	45	139	68	46	
60	187	11	5	-	-	-	203	-	6.7	-	-	6.7	-	-	40.0	-	203	169	32	96	47	46	
46	451	37	5	-	-	-	493	-	6.7	-	-	6.7	-	-	40.0	-	493	412	76	233	114	56	
24	60	5	10	-	-	-	75	-	6.7	-	-	6.7	-	-	40.0	-	75	63	12	36	18	36	
58	111	37	20	-	-	-	168	-	6.7	-	-	6.7	-	-	40.0	-	168	140	26	79	39	43	
45	706	80	20	-	-	-	806	-	6.7	-	-	6.7	-	-	40.0	-	806	673	125	381	187	62	
37	485	-	-	-	-	-	485	-	6.7	-	-	6.7	-	-	40.0	-	485	405	75	229	113	49	
65	2355	-	-	-	-	-	2355	-	6.7	-	-	6.7	-	-	40.0	-	2355	1970	365	1114	547	112	
47	374	64	25	-	-	-	463	2	6.7	13	-	6.7	-	-	40.0	-	476	397	74	225	110	659	
99	587	69	5	-	-	-	661	5	6.7	34	-	6.7	-	-	40.0	-	695	580	108	329	161	249	
24	43	27	-	-	-	-	70	-	6.7	-	-	6.7	-	-	40.0	-	70	58	11	33	16	36	
08	298	48	5	-	-	-	351	1	6.7	7	-	6.7	-	-	40.0	-	358	299	55	169	83	46	
69	136	58	10	-	-	-	204	-	6.7	-	-	6.7	-	-	40.0	-	204	170	32	96	47	42	
67	179	37	-	-	-	-	216	-	6.7	-	-	6.7	-	-	40.0	-	216	180	33	102	50	41	
36	111	11	-	-	-	-	122	-	6.7	-	-	6.7	-	-	40.0	-	122	102	19	58	28	38	
03	366	-	-	-	-	-	366	-	6.7	-	-	6.7	-	-	40.0	-	366	306	57	173	85	46	
41	111	21	-	-	-	-	132	-	6.7	-	-	6.7	-	-	40.0	-	132	110	21	63	31	38	
73	2737	-	-	-	-	-	2737	12	6.7	80	10	6.7	67	-	40.0	-	2884	2407	446	1364	670	3335	
16	3953	-	-	-	-	-	3953	-	6.7	-	-	6.7	-	-	40.0	-	3953	3300	612	1870	918	165	
58	1267	-	-	-	-	-	1267	32	6.7	214	30	6.7	201	-	40.0	-	1682	1404	260	796	391	532	
55	1258	-	-	-	-	-	1258	1	6.7	7	-	6.7	-	-	40.0	-	1265	1056	196	598	294	75	
95	1037	-	-	-	-	-	1037	-	6.7	-	-	6.7	-	-	40.0	-	1037	866	161	491	241	68	
59	918	-	-	-	-	-	918	-	6.7	-	-	6.7	-	-	40.0	-	918	766	142	434	213	64	
26	43	27	5	-	-	-	75	-	6.7	-	-	6.7	-	-	40.0	-	75	63	12	36	18	36	
00	153	122	5	-	-	-	280	-	6.7	-	-	6.7	-	-	40.0	-	280	234	43	133	65	51	
59	697	578	-	-	-	-	1275	6	6.7	40	-	6.7	-	-	40.0	-	1315	1098	204	622	305	90	
90	221	32	29	-	-	-	282	-	6.7	-	-	6.7	-	-	40.0	-	282	235	44	134	66	44	
4	-	5	5	-	-	-	10	-	6.7	-	-	6.7	-	-	40.0	-	10	8	2	5	2	34	
58	561	-	-	-	-	-	561	22	6.7	147	-	6.7	-	-	40.0	-	708	591	110	335	164	52	
86	1012	-	-	-	-	-	1012	-	6.7	-	-	6.7	-	-	40.0	-	1012	845	157	179	235	67	
98	349	-	-	-	-	-	349	-	6.7	-	-	6.7	-	-	40.0	-	349	291	54	165	81	45	
62	2992	37	-	-	-	-	3029	-	6.7	-	-	6.7	-	-	40.0	-	3029	2529	469	1433	703	135	
-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	40.0	-	-	-	-	-	-	33	
39	468	16	-	-	-	-	484	29	6.7	194	-	6.7	-	-	40.0	-	678	566	105	321	157	50	
00	145	239	15	148	107	6	660	-	6.7	-	-	6.7	-	-	40.0	-	660	551	102	312	153	63	
-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	40.0	-	-	-	-	-	-	33	
49	340	101	15	-	-	-	456	-	6.7	-	-	6.7	-	-	40.0	-	456	381	71	216	106	70	
69	417	143	176	-	-	-	736	-	6.7	-	-	6.7	-	-	40.0	-	736	614	114	348	171	76	
61	451	64	10	-	-	-	525	-	6.7	-	-	6.7	-	-	40.0	-	525	438	81	249	122	52	
29	697	281	10	-	-	-	988	-	6.7	-	-	6.7	-	-	40.0	-	988	825	153	468	230	83	
97	85	53	5	7	32	13	195	-	6.7	-	-	6.7	-	-	40.0	-	195	163	30	92	45	51	
31	51	37	-	-	-	-	88	2	6.7	13	3	6.7	20	-	40.0	-	121	101	19	57	28	47	
83	1913	233	10	481	132	11	2780	22	6.7	147	-	6.7	-	-	40.0	-	2929	2445	453	1384	680	164	
49	1947	424	15	-	-	-	2386	2	6.7	13	-	6.7	-	-	40.0	-	2399	2003	371	1135	557	238	
84	2210	684	103	-	-	-	2997	9	6.7	60	4	6.7	27	-	40.0	-	3084	2474	477	1459	716	247	
33	187	334	59	-	-	-	580	47	6.7	315	2	6.7	13	-	40.0	-	908	758	141	430	211	792	
71	2278	239	25	-	6	2	2550	14	6.7	94	-	6.7	-	-	40.0	-	2644	2207	409	1251	614	179	
35	2448	-	-	555	227	76	3306	10	6.7	67	-	6.7	-	-	40.0	-	3373	2816	522	1596	783	158	
15	238	53	49	-	-	-	340	-	6.7	-	-	6.7	-	-	40.0	-	340	284	53	161	79	47	
81	85	254	-	30	25	8	402	-	6.7	-	-	6.7	-	-	40.0	-	402	336	62	190	93	59	
32	43	32	5	-	6	-	86	-	6.7	-	-	6.7	-	-	40.0	-	86	72	13	41	20	37	
69	145	58	5	-	-	-	208	-	6.7	-	-	6.7	-	-	40.0	-	208	174	32	98	48	42	
47	1794	80	10	-	-	-	1884	-	6.7	-	-	6.7	-	-	40.0	-	1884	1573	292	891	437	196	
56	1224	21	-	-	-	-	1245	-	6.7	-	-	6.7	-	-	40.0	-	1245	1039	193	589	289	150	
10	17	11	-	-	-	-	28	12	6.7	80	-	6.7	-	-	40.0	-	108	90	17	51	25	34	
15	357	27	5	-	-	-	389	-	6.7	-	-	6.7	-	-	40.0	-	389	325	60	184	90	47	
63	570	5	-	-	-	-	575	-	6.7	-	-	6.7	-	-	40.0	-	575	480	89	272	134	53	
75	995	207	-	-	-	-	1202	0	6.7	-	-	6.7	-	-	40.0	-	1202	1003	186	569	279	106	
20	417	5	-	-	-	-	422	-	6.7	-	-	6.7	-	-	40.0	-	422	352	65	200	98	48	
69	247	207	10	-	-	-	464	-	6.7	-	-	6.7	-	-	40.0	-	464	387	72	219	108	53	
63	162	37	-	-	-	-	199	-	6.7	-	-	6.7	-	-	40.0	-	199	166	31	94	46	46	
19	43	16	-	-	-	-	59	-	6.7	-	-	6.7	-	-	40.0	-	59	49	9	28	14	36	
5,223	68,490	7311	843	3373	1518	350	81,885	406		2716	173		1161	17		680	86,442	72,159	13,384	40,893	20,070	28,652	

ERAGE NON-WHITE — BANW
ED WORK — HBW
BASED — NHB
ME BASED — OHB
UNIT — DU

L TRIPS FOR VEHICLE GARAGED INSIDE CORDON / TAL INTERNALLY GENERATED TRIPS] X 100 = 83%

31,708 = 15,854

TRIPS]

ZONE	DWELLING UNIT RATING WHITE AAW	AW	BAW	NON-WHITE AANW	ANW	BA
1	7	5	-	-	-	
2	102	30	1	-	-	
3	-	-	-	-	-	
4	-	-	-	-	-	
5	80	41	26	55	31	
6	-	-	-	45	24	
7	-	-	-	106	97	3
8	-	30	-	165	110	8
9	436	87	-	27	-	
10	432	5	-	-	-	
11	-	-	-	56	32	1
12	-	-	-	9	19	
13	172	101	-	-	-	
14	202	88	-	-	-	
15	-	-	-	-	-	
16	-	-	-	-	-	
17	3	-	-	-	-	
18	68	-	-	-	-	
19	253	17	-	-	-	
20	153	8	-	-	-	
21	333	12	-	-	-	
22	157	-	-	-	-	
23	159	-	-	-	-	
24	-	-	-	-	-	
25	557	62	-	-	-	
26	25	-	-	-	-	
27	574	-	-	-	-	
28	260	-	-	-	-	
29	-	-	-	-	-	
30	-	-	-	-	-	
31	42	40	-	5	22	
32	75	10	-	-	-	
33	115	17	-	-	-	
34	97	42	-	-	-	
35	62	43	10	-	-	
36	141	29	5	-	-	
37	326	-	-	-	-	
38	290	-	-	-	-	
39	428	136	19	-	-	
40	141	29	-	-	-	
41	45	44	-	-	-	
42	123	35	-	-	-	
43	558	453	-	-	-	
44	121	40	-	-	-	
45	198	30	-	-	-	
46	253	-	-	-	-	
47	268	82	-	-	-	
48	297	-	-	-	-	
49	500	-	-	-	-	
50	217	-	-	-	-	
51	196	-	-	-	-	
52	135	-	-	-	-	
53	228	-	-	-	-	
54	75	89	-	-	-	
55	66	88	-	-	-	
56	128	169	-	-	-	
57	171	59	20	-	-	
58	49	50	-	-	-	
59	91	-	-	-	-	
60	170	-	-	-	-	
61	216	-	-	-	-	
62	559	11	-	-	-	
63	-	-	-	-	-	
64	132	7	-	-	-	
65	22	61	-	26	25	
66	50	-	-	-	-	
67	224	123	-	-	-	
68	106	82	58	-	-	
69	169	45	-	-	-	
70	232	156	-	-	-	
71	87	95	-	9	78	2
72	105	123	-	-	-	
73	451	92	-	130	54	
74	267	97	-	-	-	
75	304	163	13	-	-	
76	29	91	9	-	-	
77	270	45	5	-	2	
78	392	-	-	102	76	2
79	230	123	41	-	-	
80	43	205	-	17	26	
81	31	43	-	-	6	
82	110	78	-	-	-	
83	234	19	-	-	-	
84	314	9	-	-	-	
85	174	174	-	-	-	
86	190	27	-	-	-	
87	104	2	-	-	-	
88	209	69	-	-	-	
89	331	7	-	-	-	
90	55	78	-	-	-	
91	89	33	-	-	-	
92	152	91	-	-	-	
TOTAL	15,462	4120	215	752	602	2

ABOVE AVERAGE WHITE — AAW
AVERAGE WHITE — AW
BELOW AVERAGE WHITE — BAW
ABOVE AVERAGE NON-WHITE — AANW
AVERAGE NON-WHITE — ANW

[a] PERCENT INTERNAL TRIPS OF TOTAL TRIPS

[b] SECONDARY NHB TRIPS = 0.50 X EXTERNAL-

[c] ZONE (X) NHB TRIPS = [ZONE (X) ATTRACT
(SUM ALL

APPENDIX B

TABLE 2

CHAPEL HILL-CARRBORO TRIP GENERATION AND TRIP PRODUCTION
FOR 1995 INTERNAL TRAFFIC

OCCUP PER UNIT	ZONE POP.	DWELLING UNIT TRIPS WHITE AAW	WHITE AW	WHITE BAW	NON-WHITE AANW	NON-WHITE ANW	NON-WHITE BANW	AUTO[a] TRIPS	TRUCK TRIPS[c] NO. VEH.	TRUCK GEN. RATE	TRUCK TRIPS	COMM. PASS. VEH.[e] NO. VEH.	GEN. RATE	VEH. TRIPS	TAXI TRIPS[f] NO. TAXIS	GEN. RATE	TAXI TRIPS	A + C + E + G TOTAL TRIPS BY ALL VEH. GAR. INSIDE	TOTAL TRIPS BY[d] ALL VEH. GAR. INSIDE WITHOUT EXT.-INT.	INT.-INT. HBW TRIPS PRODUCED 18%	INT.-INT. OHB TRIPS PRODUCED 55%	INT.-INT. NHB TRIPS PRODUCED 27%	ATTRACTION FACTOR (REG. ANALYSIS)	TOTAL NHB[b] TRIPS PRODUCED & DISTRIBUTED
2.4	29	96	43	-	-	-	-	139	52	6.7	348	98	6.7	657	-	6.7	-	1144	1025	177	541	266	6216	12785
2.4	319	1397	258	8	-	-	-	1663	31	6.7	208	3	6.7	20	-	6.7	-	1891	1694	293	894	439	290	596
2.4	-	-	-	-	-	-	-	-	48	6.7	322	14	6.7	94	-	6.7	-	416	373	64	197	97	900	1850
2.4	-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	6.7	-	-	-	-	-	-	7450	15317
2.4	570	1096	353	205	655	316	16	2641	52	6.7	348	20	6.7	134	-	6.7	-	5123	2798	483	1477	725	319	656
2.4	185	-	-	-	536	245	93	803	70	6.7	469	162	6.7	1085	48	6.7	1920	4277	3831	662	2023	993	2401	4936
2.4	559	-	-	-	1261	989	273	2343	31	6.7	208	-	6.7	-	-	6.7	-	2551	3432	593	1812	890	1025	206
2.4	945	-	258	-	1964	1122	-	3617	32	6.7	214	-	6.7	-	-	6.7	-	3831	6656	1150	3515	1725	149	306
2.4	1320	5973	748	-	321	-	-	7042	36	6.7	241	22	6.7	147	-	6.7	-	7430	5574	963	2943	1445	191	393
2.4	1049	5918	43	-	-	-	-	5961	33	6.7	221	6	6.7	40	-	6.7	-	6222	1116	193	590	289	972	1998
2.4	242	-	-	-	666	326	40	1032	32	6.7	214	-	6.7	-	-	6.7	-	1246	539	93	285	140	100	206
2.4	68	-	-	-	107	194	-	301	42	6.7	281	3	6.7	20	-	6.7	-	602	2889	499	1526	749	1031	2120
2.4	655	2356	869	-	-	-	-	3225	-	6.7	-	-	6.7	-	-	6.7	-	3225	1667	546	1667	818	112	230
2.4	696	2767	757	-	-	-	-	3524	-	6.7	-	-	6.7	-	-	6.7	-	3524	3166	-	-	-	116	238
2.4	-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	6.7	-	-	-	-	-	-	4128	8487
2.4	-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	6.7	-	-	-	-	-	-	792	1628
2.4	-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	6.7	-	-	-	-	-	-	1239	2547
2.4	7	41	-	-	-	-	-	41	-	6.7	-	-	6.7	-	-	6.7	-	41	37	6	19	9	53	110
2.4	163	932	-	-	-	-	-	932	-	6.7	-	-	6.7	-	-	6.7	-	932	835	144	441	217	111	228
2.4	648	3466	146	-	-	-	-	3612	-	6.7	-	-	6.7	-	-	6.7	-	3612	3256	559	1708	839	79	162
2.4	386	2096	69	-	-	-	-	2165	-	6.7	-	-	6.7	-	-	6.7	-	2165	1939	355	1024	503	659	1314
2.4	828	4562	103	-	-	-	-	4665	59	6.7	395	11	6.7	74	-	6.7	-	5134	4599	795	2428	1192	78	160
2.4	377	2151	-	-	-	-	-	2151	-	6.7	-	-	6.7	-	-	6.7	-	2151	1927	333	1018	500	79	162
2.4	382	2178	-	-	-	-	-	2178	-	6.7	-	3	6.7	20	-	6.7	-	2198	1969	340	1040	510	655	1547
2.4	-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	6.7	-	-	-	-	-	-	211	454
2.4	1486	7631	533	-	-	-	-	8164	-	6.7	-	-	6.7	-	-	6.7	-	8164	7313	1264	3862	1896	40	82
2.4	60	343	-	-	-	-	-	343	-	6.7	-	6	6.7	40	-	6.7	-	383	343	59	181	89	198	407
2.4	1378	7864	-	-	-	-	-	7864	-	6.7	-	-	6.7	-	-	6.7	-	7864	7044	1217	3720	1826	108	222
2.4	624	3562	-	-	-	-	-	3562	-	6.7	-	-	6.7	-	-	6.7	-	3562	3191	551	1685	827	33	68
2.4	-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	6.7	-	-	-	-	-	-	33	68
2.4	-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	6.7	-	-	-	-	-	-	64	132
2.4	-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	6.7	-	-	-	-	-	-	74	152
2.4	262	575	344	-	60	224	-	1203	-	6.7	-	-	6.7	-	-	6.7	-	1203	1078	186	569	279	87	179
2.4	204	1028	86	-	-	-	-	1114	-	6.7	-	-	6.7	-	-	6.7	-	1114	998	172	527	259	73	150
2.4	317	1576	146	-	-	-	-	1722	-	6.7	-	-	6.7	-	-	6.7	-	1722	1543	267	815	400	74	152
2.4	334	1329	361	-	-	-	-	1690	-	6.7	-	-	6.7	-	-	6.7	-	1690	1514	262	799	392	83	171
2.4	276	849	370	79	-	-	-	1298	-	6.7	-	-	6.7	-	-	6.7	-	1298	1163	201	614	301	127	261
2.4	415	1932	249	24	-	-	-	2205	-	6.7	-	-	6.7	-	-	6.7	-	2205	1975	341	1043	512	117	241
2.4	782	4466	-	-	-	-	-	4466	-	6.7	-	-	6.7	-	-	6.7	-	4466	4001	691	2113	1037	1185	2436
2.4	696	3973	-	-	-	-	-	3973	-	6.7	-	-	6.7	-	-	6.7	-	3973	3559	615	1879	923	1736	1542
2.4	1423	5864	1170	229	-	-	-	7263	32	6.7	214	-	6.7	-	-	6.7	-	7477	6698	1157	3537	1736	750	121
2.4	408	1932	249	-	-	-	-	2181	35	6.7	235	-	6.7	-	-	6.7	-	2416	2164	374	1143	561	59	160
2.4	214	617	378	-	-	-	-	995	-	6.7	-	-	6.7	-	-	6.7	-	995	891	154	471	231	78	666
2.4	379	1685	301	-	-	-	-	1986	31	6.7	208	-	6.7	-	-	6.7	-	2194	1965	340	1038	509	324	162
2.4	2426	7645	3896	-	-	-	-	11541	-	6.7	-	-	6.7	-	-	6.7	-	11541	10338	1787	5459	2680	79	204
2.4	586	1658	344	-	-	-	-	2002	-	6.7	-	-	6.7	-	-	6.7	-	2002	1793	310	947	465	99	218
2.4	547	2713	258	-	-	-	-	2971	-	6.7	-	-	6.7	-	-	6.7	-	2971	2661	460	1405	690	106	275
2.4	607	3466	-	-	-	-	-	3466	-	6.7	-	-	6.7	-	-	6.7	-	3466	3105	537	1640	805	134	11047
2.4	840	3672	705	-	-	-	-	4377	-	6.7	-	-	6.7	-	-	6.7	-	4377	3921	678	2070	1016	5373	364
2.4	713	4069	-	-	-	-	-	4069	32	6.7	214	28	6.7	188	-	6.7	-	4471	4005	692	2115	1038	177	3294
2.4	1200	6850	-	-	-	-	-	6850	-	6.7	-	-	6.7	-	-	6.7	-	6850	6136	1060	3240	1591	1602	185
2.4	521	2973	-	-	-	-	-	2973	62	6.7	415	84	6.7	563	-	6.7	-	5951	3539	612	1869	917	89	148
2.4	470	2685	-	-	-	-	-	2685	31	6.7	208	-	6.7	-	-	6.7	-	2893	2591	448	1368	672	72	204
2.4	324	1850	-	-	-	-	-	1850	-	6.7	-	-	6.7	-	-	6.7	-	1850	1657	286	875	430	99	164
2.4	547	3124	-	-	-	-	-	3124	-	6.7	-	-	6.7	-	-	6.7	-	3124	2798	484	1478	725	80	175
2.4	394	1028	765	-	-	-	-	1793	-	6.7	-	-	6.7	-	-	6.7	-	1793	1606	278	848	416	85	255
2.4	369	904	757	-	-	-	-	1661	-	6.7	-	-	6.7	-	-	6.7	-	1661	1588	257	785	386	124	216
2.4	713	1754	1453	-	-	-	-	3207	6	6.7	40	-	6.7	-	-	6.7	-	3247	2909	503	1536	754	105	127
2.4	600	2343	507	158	-	-	-	3008	-	6.7	-	-	6.7	-	-	6.7	-	3008	2694	466	1423	698	82	121
2.4	238	671	430	-	-	-	-	1101	-	6.7	-	-	6.7	-	-	6.7	-	1101	986	170	521	256	59	169
2.4	218	1247	-	-	-	-	-	1247	38	6.7	255	-	6.7	-	-	6.7	-	1502	1345	233	711	349	82	195
2.4	408	2329	-	-	-	-	-	2329	-	6.7	-	-	6.7	-	-	6.7	-	2329	2086	361	1102	541	95	405
2.4	518	2959	-	-	-	-	-	2959	-	6.7	-	-	6.7	-	-	6.7	-	2959	2651	458	1400	687	197	68
2.4	1368	7658	95	-	-	-	-	7753	-	6.7	-	-	6.7	-	-	6.7	-	7753	6945	1200	3667	1800	55	150
2.4	-	-	-	-	-	-	-	-	-	6.7	-	-	6.7	-	-	6.7	-	-	-	-	-	-	73	148
2.4	334	1808	60	-	-	-	-	1858	49	6.7	328	-	6.7	-	-	6.7	-	2196	1967	340	1039	510	72	97
2.4	321	301	525	-	309	255	-	1390	-	6.7	-	-	6.7	-	-	6.7	-	1390	1245	215	657	323	47	352
2.4	120	685	-	-	-	-	-	685	-	6.7	-	-	6.7	-	-	6.7	-	685	614	106	324	159	171	259
2.4	833	3069	1058	-	-	-	-	4127	-	6.7	-	-	6.7	-	-	6.7	-	4127	3697	639	1952	958	126	195
2.4	595	1480	705	458	-	-	-	2643	-	6.7	-	-	6.7	-	-	6.7	-	2643	2368	409	1250	614	95	343
2.4	514	2315	387	-	-	-	-	1702	-	6.7	-	-	6.7	-	-	6.7	-	2702	2420	418	1278	627	167	275
2.4	931	1378	1342	-	-	-	-	4520	-	6.7	-	-	6.7	-	-	6.7	-	4520	4049	700	2138	1049	134	243
2.4	708	1192	817	-	107	796	81	2993	-	6.7	-	-	6.7	-	-	6.7	-	2993	2681	463	1416	695	118	623
2.4	547	1439	1058	-	-	-	-	2497	17	6.7	114	8	6.7	54	-	6.7	-	2665	2387	413	1261	619	303	870
2.4	1745	6179	791	-	1547	551	-	9068	24	6.7	161	-	6.7	-	-	6.7	-	9229	8267	1429	4365	2143	423	750
2.4	874	3658	834	-	-	-	-	4492	32	6.7	214	-	6.7	-	-	6.7	-	4706	4215	728	2226	1093	365	3892
2.4	1152	4165	1402	103	-	-	-	5670	39	6.7	261	11	6.7	74	-	6.7	-	6005	5379	930	2840	1394	1893	541
2.4	310	397	783	71	-	-	-	1251	72	6.7	482	6	6.7	40	-	6.7	-	1773	1588	275	839	412	263	421
2.4	773	3699	387	40	-	20	-	4146	44	6.7	295	-	6.7	-	-	6.7	-	4441	3978	687	2100	1031	205	302
2.4	1433	5370	-	-	1214	775	54	7443	30	6.7	201	-	6.7	-	-	6.7	-	7644	6847	1183	3616	1775	147	267
2.4	945	3151	1058	324	-	-	-	4533	-	6.7	-	-	6.7	-	-	6.7	-	4533	4061	702	2144	1052	130	115
2.4	717	589	1763	-	202	265	25	2844	-	6.7	-	-	6.7	-	-	6.7	-	2844	2548	440	1345	660	56	179
2.4	191	425	370	-	-	61	-	856	-	6.7	-	-	6.7	-	-	6.7	-	856	767	132	405	199	87	648
2.4	451	1507	671	-	-	-	-	2178	-	6.7	-	-	6.7	-	-	6.7	-	2178	1951	337	1030	506	315	504
2.4	608	3206	163	-	-	-	-	3369	-	6.7	-	-	6.7	-	-	6.7	-	3369	3018	521	1593	782	245	275
2.4	776	4302	77	-	-	-	-	4379	-	6.7	-	-	6.7	-	-	6.7	-	4379	3923	678	2071	1017	133	197
2.4	836	2384	1496	-	-	-	-	3880	26	6.7	174	-	6.7	-	-	6.7	-	4054	3631	627	1917	941	96	130
2.4	521	2603	232	-	-	-	-	2835	20	6.7	134	-	6.7	-	-	6.7	-	2969	2660	460	1404	689	63	331
2.4	255	1425	17	-	-	-	-	1442	-	6.7	-	-	6.7	-	-	6.7	-	1442	1292	223	682	335	161	267
2.4	668	2863	593	-	-	-	-	3456	-	6.7	-	-	6.7	-	-	6.7	-	3456	3096	535	1635	802	130	146
2.4	811	4535	60	-	-	-	-	4595	-	6.7	-	-	6.7	-	-	6.7	-	4595	4116	711	2174	1067	71	156
2.4	319	754	671	-	-	-	-	1425	-	6.7	-	-	6.7	-	-	6.7	-	1425	1276	221	674	331	76	212
2.4	293	1219	284	-	-	-	-	1503	-	6.7	-	-	6.7	-	-	6.7	-	1503	1346	233	711	349	103	
2.4	583	2082	783	-	-	-	-	2865	-	6.7	-	-	6.7	-	-	6.7	-	2865	2566	444	1353	665		96,542
	51,253	211,833	35,431	1699	8949	6139	634	264,685	1138		7622	485		3250	48		1920	277,477	248,557	42,593	131,251	64,429	46,938	

E NON-WHITE — BANW
ORK — HBW
ED — NHB
ASED — OHB
T — DU

RNAL TRIPS FOR VEHICLE GARAGED INSIDE CORDON / TOTAL INTERNALLY GENERATED TRIPS] X 100

50 X 64,200 = 32,100

B TRIPS]

APPENDIX B

TABLE 3

TOTAL TRIPS PER DAY			
Year	Total External-Internal Trips	Total Internal Trips	Total Through Trips
1971	43,992	90,179	3,276
1995	88,811	270,706	6,781

APPENDIX B

TABLE 3

APPENDIX C

Chapel Hill's List of Policies

After review of the rough draft of the report to the Thoroughfare Plan, the staff of the Planning Department, Town of Chapel Hill, requested the following comments on their policies be included in the report:

Policies

At the Thoroughfare Plan Public Forum held January 15, 1974, the following policies were recommended for inclusion in the Plan. No reference is made to these policies as a set in the text. The staff requests that these policies be included in the text, and utilized or at least addressed in the recommended plan.

1. Major thoroughfares should cause the minimum possible disruption within the areas they traverse. Thus, they should be so routed as to separate incompatible land uses where possible, and should not split cohesive residential neighborhoods, commercial complexes, or major areas of pedestrian activity. The taking of schools, parks, stream beds, and other public amenities for rights-of-way must be avoided.

2. The existing investment in streets and highways shall be used to the maximum extent possible, by, for example, removing on-street parking, signal improvements, selective widening, operational improvements, and the reduction of pedestrian-vehicle conflicts.

3. A car intercept strategy should be developed and continuously strengthened through policy decisions and public investment in the CBD-UNC Campus Area. This strategy includes the development of parking capacity at the periphery of the pedestrian areas, the integration of parking areas and bus service, and incentives and penalties designed to achieve more use of peripheral parking.

4. The use of alternative means of transportation other than the private auto shall be maximized. This includes walking, buses and bicycles. The implementation of this policy should include close coordination between bus services and parking areas, the provision for separation of pedestrian and bicycle traffic from vehicular traffic, and the development of a pedestrian circulation system.

5. Major thoroughfares shall serve to provide access to and between major neighborhood centers and shall be integrated with the intercity movement system.

6. The intersection of local streets with major thoroughfares shall be kept to a minimum in order to lessen conflicts with entering traffic. To the extent possible, vehicular access to properties abutting major thoroughfares shall be restricted to local streets by means of subdivision patterns, frontage roads, and common driveways, in order to minimize traffic flow friction due to entering vehicles.

7. Thoroughfares should be designed to provide adequate capacity and to maximize safety and convenience.

8. On all new thoroughfares construction, the shoulder width shall be widened to provide for a bicycle path and a sidewalk along each side of the right-of-way.

Mike Jennings
Planning Director
Town of Chapel Hill

APPENDIX D

Further Analysis of the Columbia-Pittsboro One-Way Pair

The request was made for a detailed study concerning the feasibility of a two-way operation of Columbia Street and the deletion of Pittsboro Street from the Recommended Thoroughfare Plan. The study involved the making of necessary link-node changes and loading the design year (1995) triptables on the revised transportation network. This appendix gives some of the findings and subsequent conclusions based on the new assignment.

The Recommended Thoroughfare Plan (Alternate "D") portrays Columbia Street and Pittsboro Street in a one-way pair situation justified by the inherent advantages of a one-way operation over a two-way operation. However, one obvious problem with this particular one-way pair concept is that Pittsboro Street presently terminates at Cameron Avenue, thereby necessitating new construction of Pittsboro Street northward to Rosemary Street before its subsequent one-way pairing. An extension of Pittsboro Street would require the taking of some noteworthy structures including a fraternity house, Walker Funeral Home, and the Shack.

However, it is felt that the disruption caused by new construction on Pittsboro Street extension is more than compensated by the limited widening (7 feet from NC 54 Business to Cameron Avenue required on Columbia Street. Capacity Calculations based on a "D" level of service for a two-way operation show that intersection approach widths on Columbia should be at least 70 feet. This translates to 41 feet of widening from NC 54 Business to Cameron Avenue and 19 feet of widening from Cameron Avenue to Franklin Street.

If widening could be restricted to Columbia Street then a two-way operation plan could be a viable alternative to the one-way pair. Such, however, is not the case for this situation. The systems approach to transportation planning reveals the impacts on individual components of the system whenever one or more facilities are added, deleted, and/or manipulated in any way. Therefore, after the link-node system was revised by deleting Pittsboro Street and recoding Columbia Street to a two-way operation, a new computer traffic assignment was conducted to determine the effects on the remaining

components of the system. An inspection of this new assignment showed that nearby streets (and one facility in Carrboro) displayed an inordinate volume burden and in general the new assignment vividly illustrated an undesirable traffic flow pattern around the Chapel Hill CBD and the University.

The facilities most adversely affected with increased traffic volumes are shown below:

Facility	Columbia Pittsboro One-Way Operation Volume	Columbia two-way Oper. Vol.
Manning Drive	8819	15923
Ridge Road	5563	13427
Raleigh Street	12505	19007
Hillsborough Street	12251	20171
NC 54 Bypass (from US 15-501 to Smith Level RD)	17564	25393
South Greensboro Street (from Old Pittsboro RD. to Main Street	19864	23398

Nearly all the above listed streets would require additional widening (above that already proposed in Alternate "D") even after extensive widening of Columbia Street had been accomplished for its two-way operation.

Although no detailed analysis was performed on the Franklin-Rosemary one-way pair versus a two-way operation, it was the study staff's opinion that study findings would be analogous to those in the Columbia-Pittsboro situation.

What could be said concerning the alternative of having no one-way situations at all? It can safely be said that a transportation plan without any one-way components would not have any of the following advantages:

(1) reduction in the number of vehicular and pedestrian conflicts resulting in reduced accidents.

(2) higher lane capacity

(3) less friction from both off and on street parking.

(4) balancing of traffic load on major radial or crosstown streets

(5) promotion of better land use in residential sections and the prevention of residential street misuse.

Based on the preceeding discussion and analysis, it can be assumed that unless some one-way concepts are integrated with the Chapel Hill-Carrboro Transportation Plan, many streets in and around Chapel Hill's CBD and the University would require (by design year 1995) some very disruptive widening without necessarily improving traffic flow conditions, especially cross town.

APPENDIX D

TABLE 1

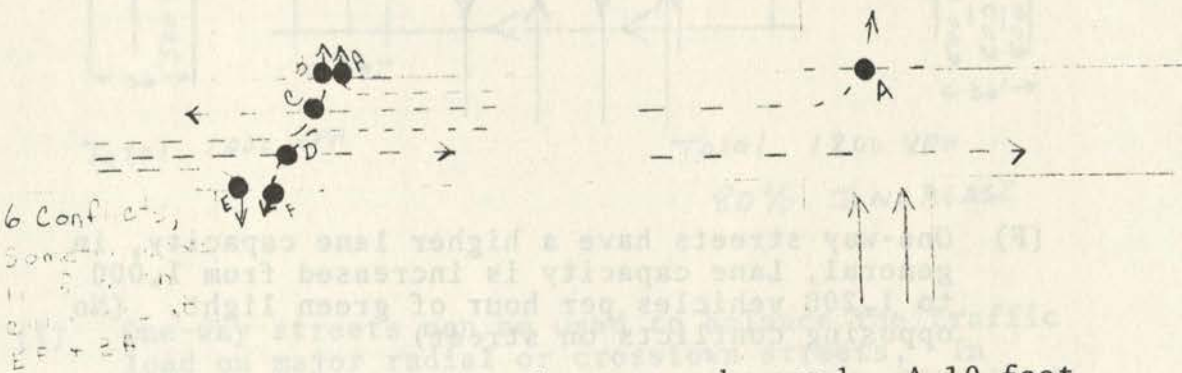
ONE-WAY STREETS

I. Advantages of the One-Way System:

(At the intersection)

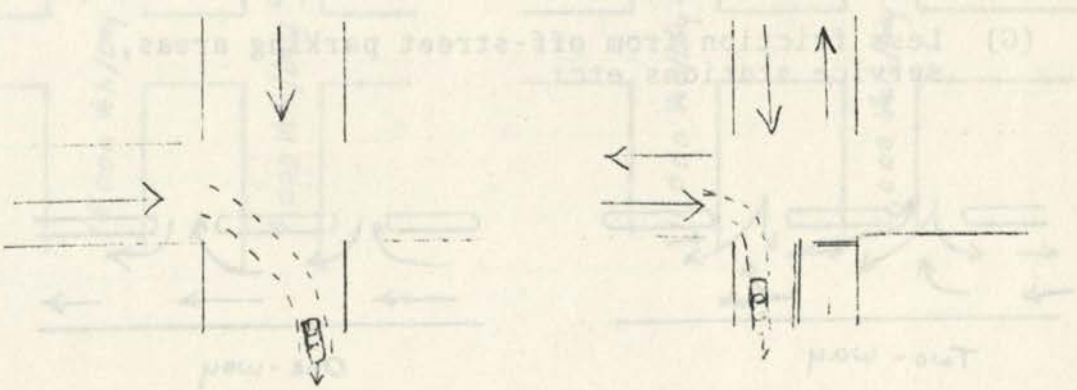
(A) A reduction in the number of vehicular and pedestrian conflicts.

Signalized Condition



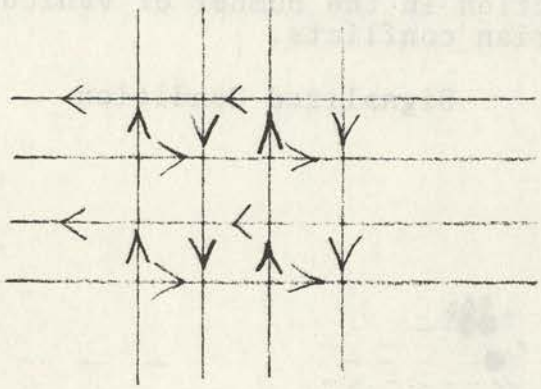
(B) In general narrower lanes can be used. A 10 foot lane on a one-way street will have as much capacity as 11 or 12 foot lanes on two-way streets. (Increase in capacity is because of no opposing traffic)

(C) More efficient for turns at intersections with very sharp radii of turn. (Turn can be made without being forced to stay within the centerline)



(D) For a continuous street, traffic signal coordination is improved greatly. Signals may be coordinated for any desired speed. Special coordinations may be used for side street traffic.

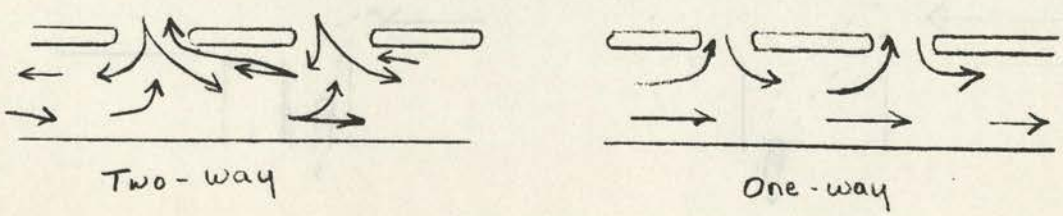
(E) For the entire block system in the central area. If block spacing is reasonably uniform it is possible to coordinate for all movements. In a two way system this may be impossible for certain block lengths.



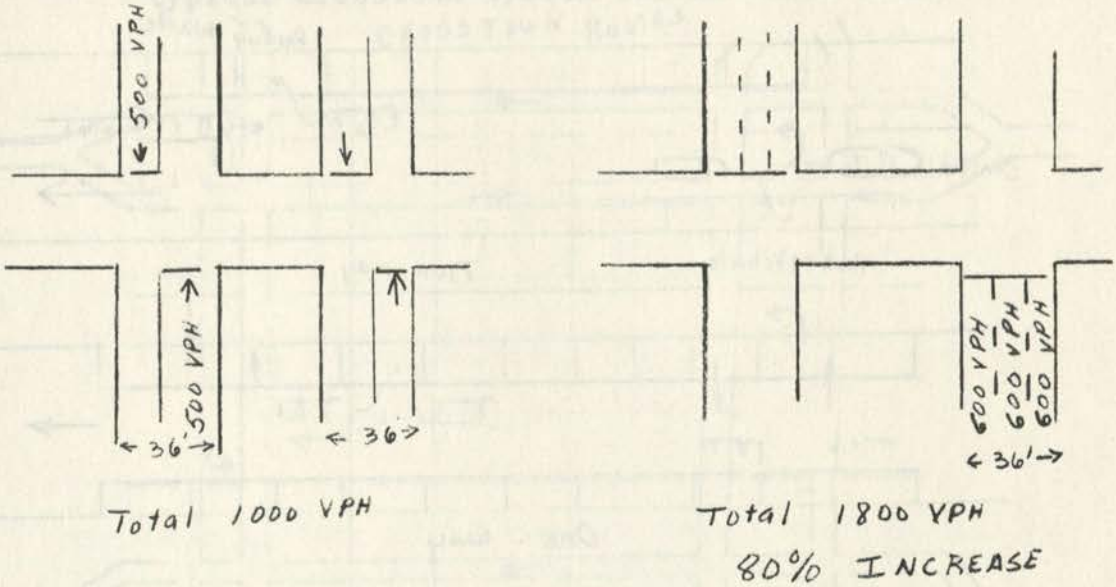
Easier to coordinate signals in one-way system.

(F) One-way streets have a higher lane capacity, in general, Lane capacity is increased from 1,000 to 1,200 vehicles per hour of green light. (No opposing conflicts on street)

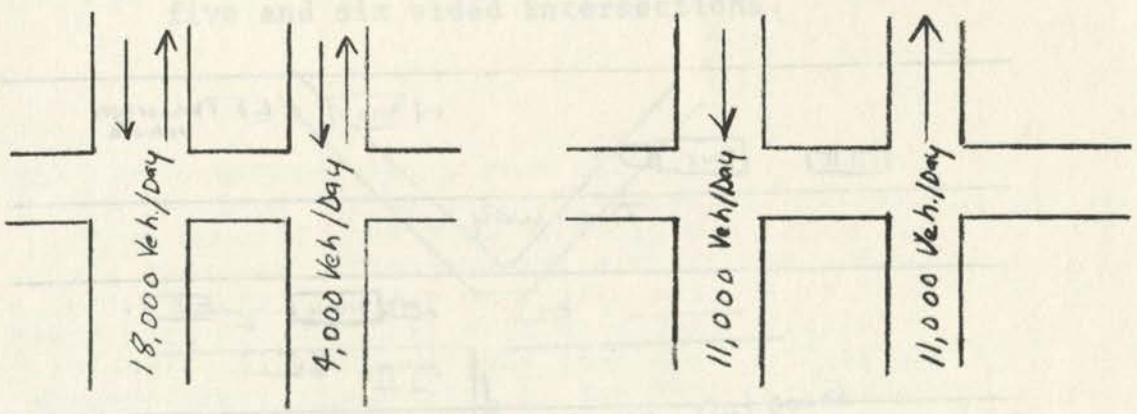
(G) Less friction from off-street parking areas, service stations etc:



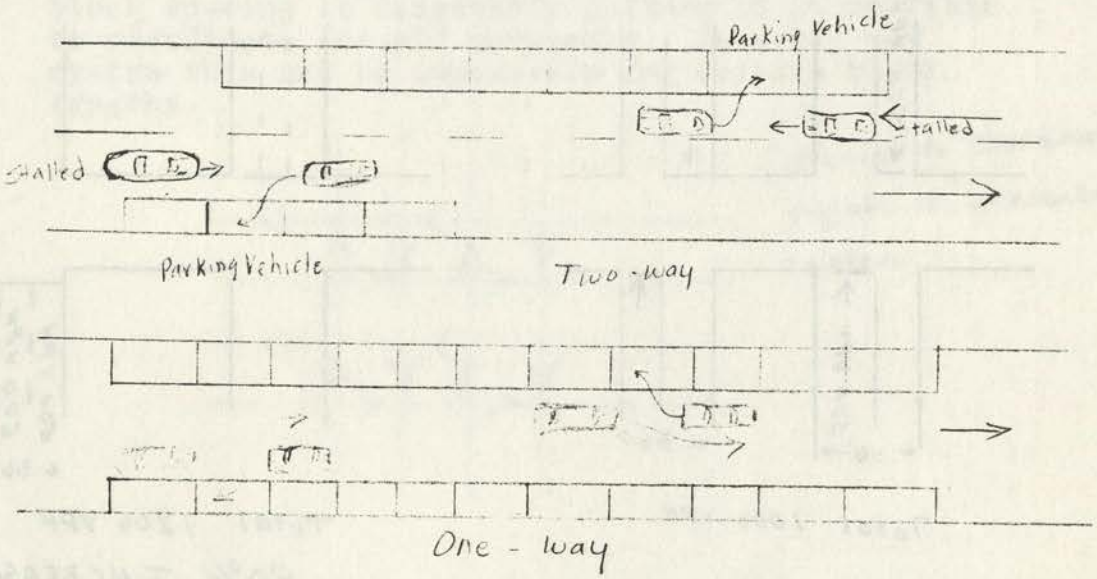
(H) One-way streets increase the capacity of the traffic system where street widths give an odd-number of lanes. Particularly for street widths (traffic lanes) from 30 feet to 35 feet. (see Figure).



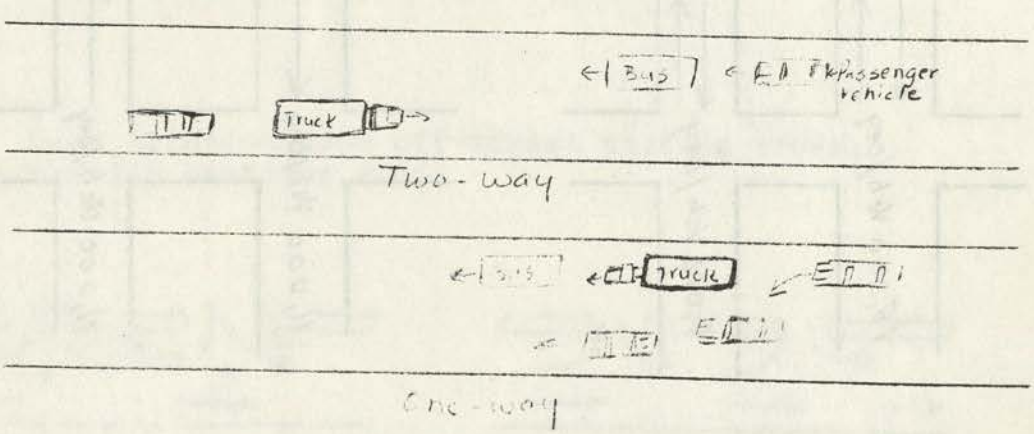
(I) One-way streets can be used to balance the traffic load on major radial or crosstown streets, In many cases one-street carries most of traffic load with a paralleling street being used only for overflow traffic at peak hours.



(J) In the central area where on-street parking and/or loading must be permitted one-way couplets can be used for narrow streets. On the two-way street traffic movement may be halted by one parking maneuver. On the one-way street traffic may move around the parking vehicles.

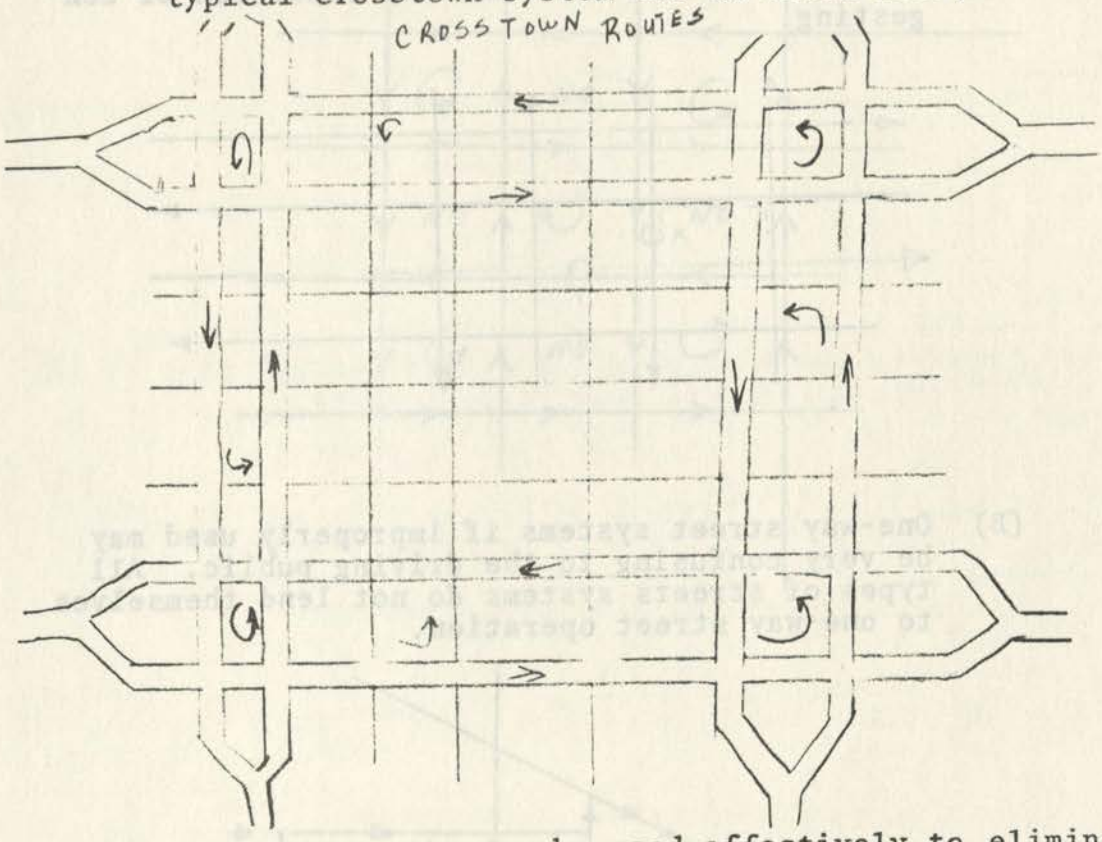


(K) On narrow streets having only two lane operation, commercial vehicles and busses may slow down traffic and reduce effective capacity of street system. The use of one-way pairs permits passenger vehicles to pass commercial vehicles.

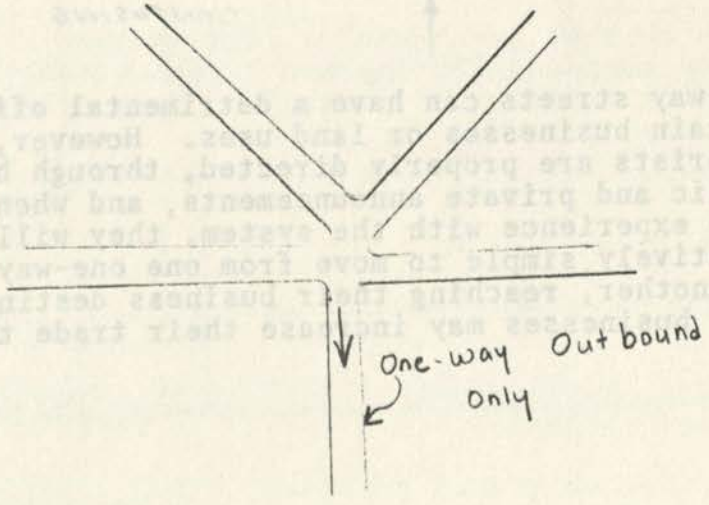


(L) Accident rates are normally lower on one-way street systems. Elimination of certain head-on types of accidents.

(M) One-way street systems can handle heavy left-turning movements with ample storage facilities in and around the central business area. (Note typical crosstown system for an urban area)

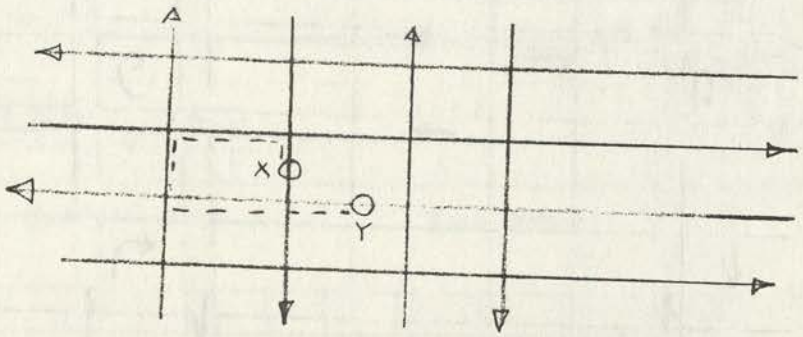


(N) One-way streets may be used effectively to eliminate five and six sided intersections.

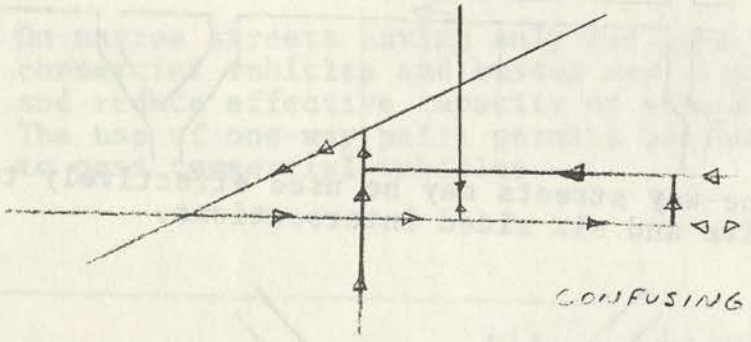


II. Disadvantages of One-Way Streets:

(A) One-way streets may increase the driving in an area. Certain trips may be made considerably longer because of the orientation of the one-way streets. However, the actual time spent on the trip and driver's frustration may lessen due to better travel flow and the reduction of congesting.

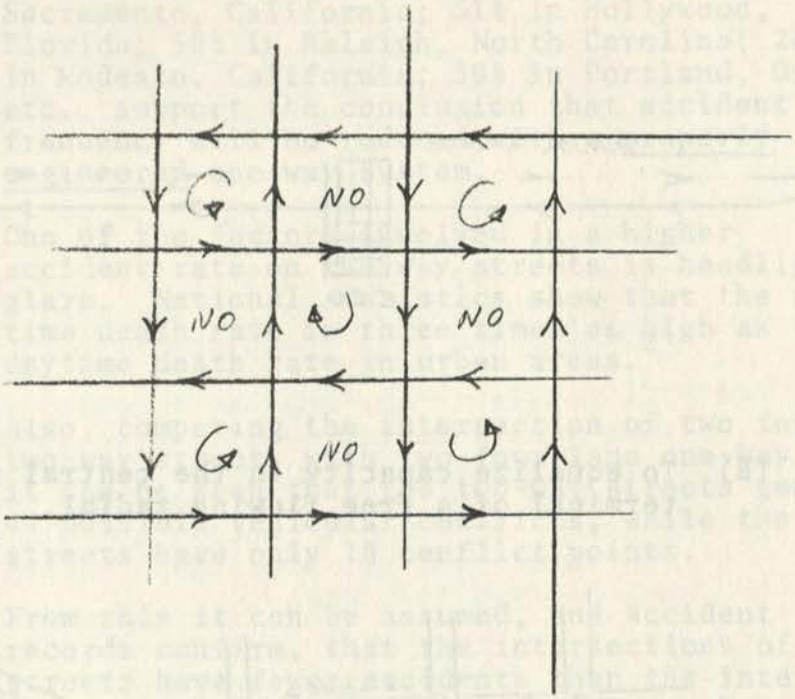


(B) One-way street systems if improperly used may be very confusing to the driving public. All types of streets systems do not lend themselves to one-way street operation.



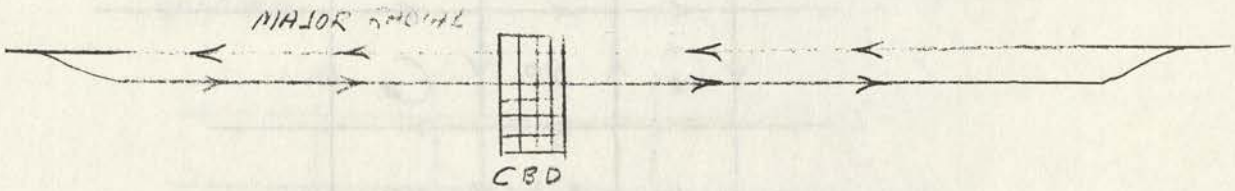
(C) One-way streets can have a detrimental effect upon certain businesses or land uses. However, if motorists are properly directed, through both public and private announcements, and when they have experience with the system, they will find it relatively simple to move from one one-way street to another, reaching their business destination. Many businesses may increase their trade through

the improved accessibility of a one-way street system.

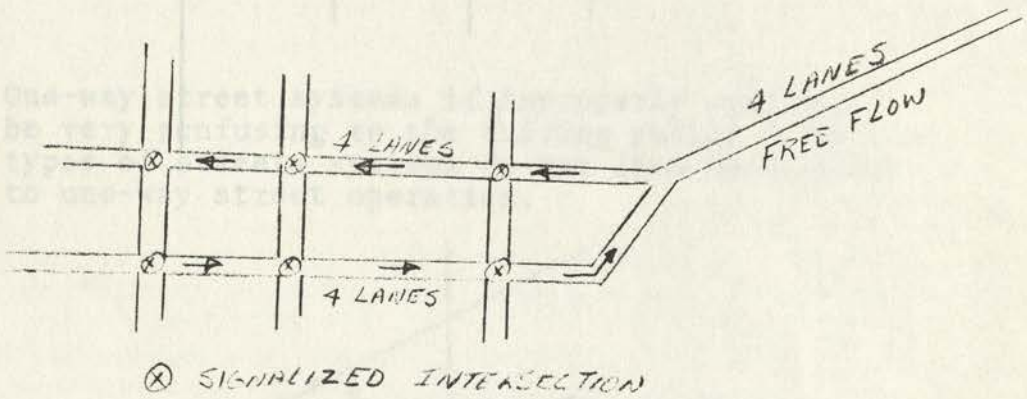


III. Specific Uses of One-Way Streets.

(A) To obtain more capacity for major radial streets moving to the business area.

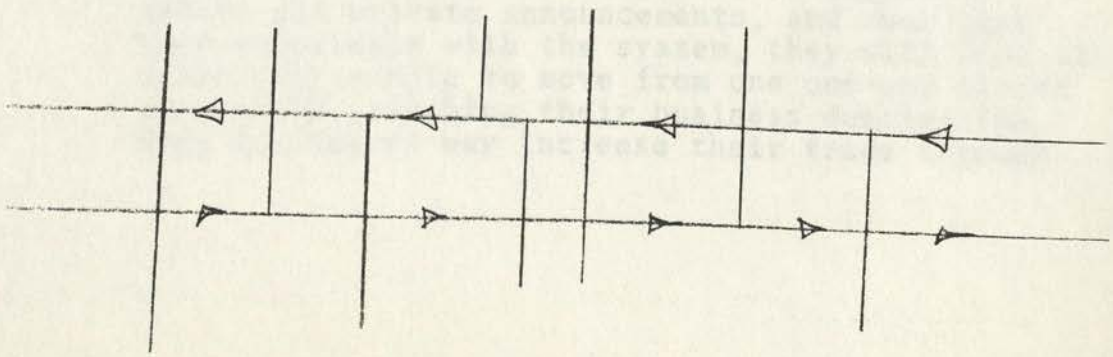


(B) To equalize capacity in the central area at the terminal of a free flowing radial.



(C) For Central business areas with a rectangular pattern.

(D) For central areas with a large number of offset intersections (To improve signal operation and reduce turning conflicts)



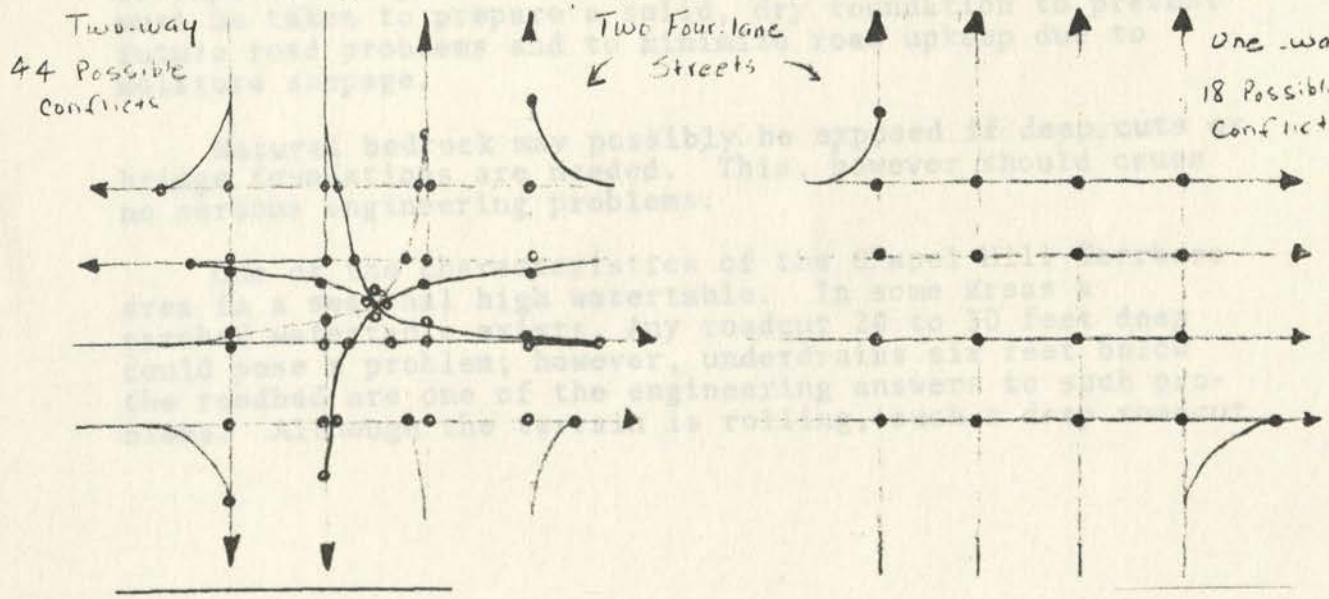
V. Safety

(A) After initiating a system of one-way pairs, reports such as a 23% drop in total accidents, and a 62% drop in pedestrian accidents in Sacramento, California; 51% in Hollywood, Florida; 50% in Raleigh, North Carolina; 28% in Modesto, California; 50% in Portland, Oregon, etc., support the conclusion that accident frequency will be reduced with a properly engineered one-way system.

One of the factors involved in a higher accident rate on two-way streets is headlight glare. National statistics show that the night-time death rate is three times as high as the daytime death rate in urban areas.[2]

(B) Also, comparing the intersection of two four-lane two-way streets with two four-lane one-way streets, it can be seen that the two-way streets generate 44 possible vehicular conflicts, while the one-way streets have only 18 conflict points.

From this it can be assumed, and accident records confirm, that the intersections of one-way streets have fewer accidents than the intersections of two-way streets. Also it follows that one-way street intersections with fewer conflicts have greater carrying capacity.



[1] Fundamentals of Traffic Engineering, Kennedy, Kell & Homburger, University of California, Berkeley, 1963.

[2] Accident Facts, National Safety Council, 425 N. Michigan Avenue, Chicago, 1963, P. 47.

V. Other Considerations:

(A) It is essential that the streets chosen for one-way operation be reasonably parallel and close together. Streets one-quarter of a mile apart are in successful operation, but this is probably a maximum for the required cross-circulation between the two halves of a one-way street system. Usually, paired one-way streets are only one block apart.

(B) Another essential is that the one-way system has properly designed terminal points. Most one-way streets transition back to two-way operation, and these transitions must be designed for full capacity and full speed operation.

(C) The design of the one-way streets, once selected, must also give consideration to such things as some increase in the number of turns and travel distance that will occur for some drivers, the problems of transit routing and bus stops, fire apparatus routing, additional signalization which may be required, etc.

APPENDIX E

Geologic Overview of the Chapel Hill-Carrboro Area

The towns of Chapel Hill and Carrboro lie in the extreme western boundary of the Triassic Basin. This is the only portion of Orange County where the basin is exposed. The Basin consists of unmetamorphosed rocks of Triassic age that have been downfaulted into the older metamorphic and igneous formations. The Triassic formations are mostly red beds of sandstone, conglomerate, and silt, but include dikes and sills of diabase. This Triassic Basin is known as the Deep River Basin of North Carolina.

Because of the humid climate and crude early farming techniques used in this area during the early settlement period, much of the top soil was eroded. This top soil was known as the A-horizon.

This area is primarily B-soil horizon and experiences the problems associated with the past heavy erosion experienced by most of the Piedmont.

The B-soil horizon in this area is composed of some highly plastic clays which cause some problems with road building. They are badly affected by water and a high watertable in the area. Because of the high moisture content, construction sites are often hard to dry and compact. Often material must be imported to give a sound foundation to road projects. Care must be taken to prepare a solid, dry foundation to prevent future road problems and to minimize road upkeep due to moisture seepage.

Natural bedrock may possibly be exposed if deep cuts or bridge foundations are needed. This, however, should cause no serious engineering problems.

One of the characteristics of the Chapel Hill-Carrboro area is a seasonal high watertable. In some areas a perched watertable exists. Any roadcut 20 to 30 feet deep could pose a problem; however, underdrains six feet below the roadbed are one of the engineering answers to such problems. Although the terrain is rolling, such a deep roadcut

generally would not be required and the problem drainage situation would seldom occur. Generally road construction of this nature would not lower the watertable and there would be no adverse effect on the Chapel Hill-Carrboro water supply.

The danger to the area of erosion due to the possible road construction is medium; however, the danger of erosion from other factors such as farming is greater because of the precautionary measures such as erosion barriors and siltation basions included in each road project. These engineering measures fairly well stop the possibility of erosion.

This area of Orange County is only fair in its suitability for road construction; however, the characteristics which make it a difficult construction site, the high placticity of the Clays and slow permcability; also, are highly effected by traffic overuse and misuse. The high shrink swell potential creates conditions of poor traffic supporting capacity when the design capacity of the roadway is consistently exceeded.

When roadways are used to carry their design capacity, there is less damage to pavement surfaces and conditions of pot holes and sinking pavement are not as prevelant. This can in turn result in fewer dollars spent in upkeep of existing roadways and more pleasant driving conditions.