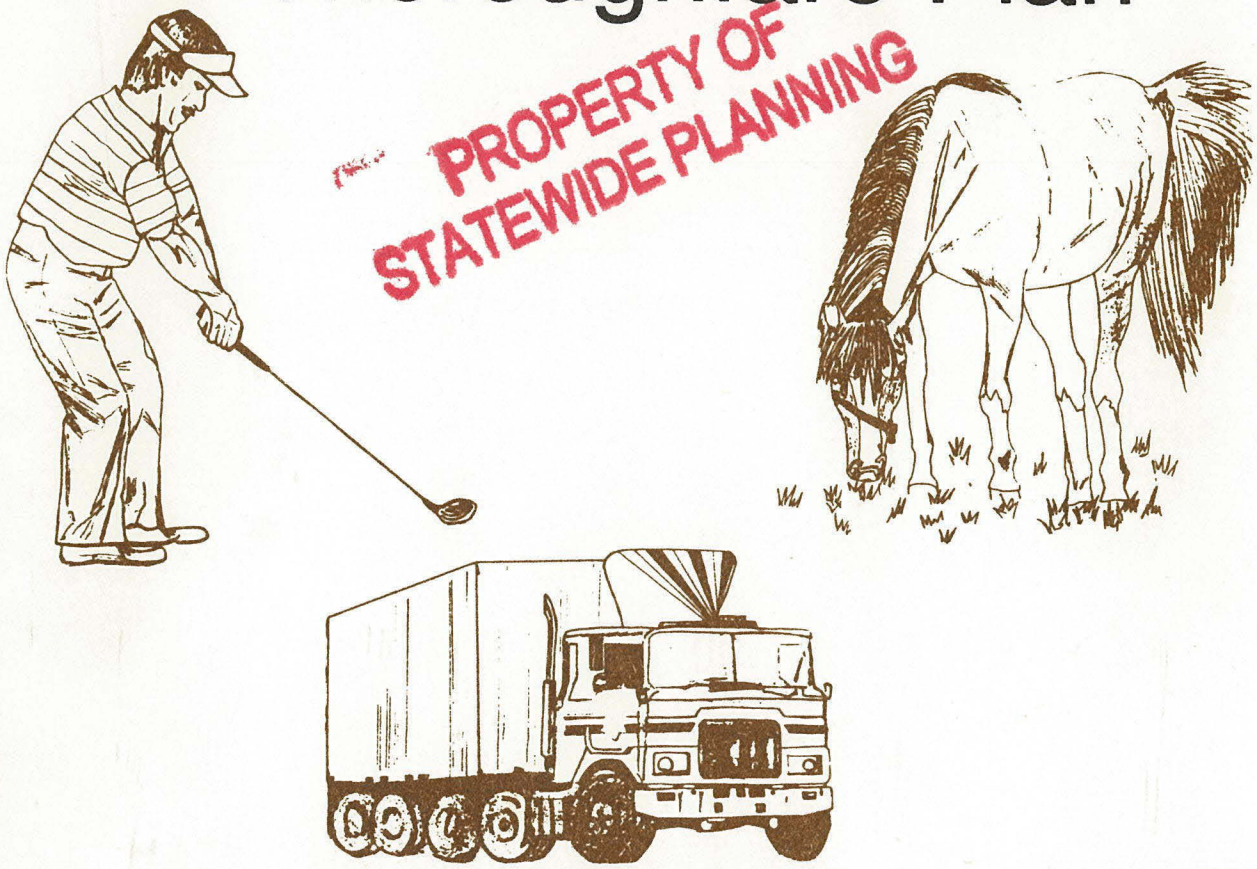
North Carolina Department of Transportation
Planning and Environmental Branch
Statewide Planning Group
Thoroughfare Planning Unit

Southern Pines
Aberdeen
Pinehurst
Thoroughfare Plan



1990

SOUTHERN PINES-ABERDEEN-PINEHURST THOROUGHFARE PLAN

PREPARED BY: Statewide Planning Group
Planning and Environmental Branch
Division of Highways
N.C. Department of Transportation

IN COOPERATION WITH: Town of Southern Pines
Town of Aberdeen
Village of Pinehurst
Town of Taylortown
Moore County

DECEMBER, 1990

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I. INTRODUCTION

The economic growth of a region can be greatly influenced by the efficiency of the transportation system for the area. If the system fails to provide for the quick and convenient transport of people and goods, the region's economic growth fails to reach its full potential. It is essential that the transportation system not only meet the existing demand but also keep pace with the increased growth of the area.

The Sandhills area of Moore County has grown a lot in the twelve years since the last thoroughfare plan study was completed in 1977. Only one of the recommendations from that plan has been implemented--the intersection of Morganton Road and US 15-501 has been realigned.

There are several current NCDOT Transportation Improvement Program roadway projects in the area, though. US15-501 between Pinehurst and Aberdeen is being widened. Morganton Road is to be widened from US15-501 to Broad Street in Southern Pines. The bridge carrying NC5 at US1 in Aberdeen is to be relocated. NC211 will be relocated to bypass Pinehurst and then widened through Aberdeen. The feasibility of a US1 bypass of Southern Pines and Aberdeen will be looked at in this study.

The purpose of this study was to examine the present and future needs of the Sandhills area and from this formulate a thoroughfare plan more consistent with those new conditions. This Plan will provide guidance for the future development of the major street system in the Sandhills area to meet existing and future travel desires; to ensure the development of a coordinated street system as land development occurs; to reduce travel and transportation costs to the public; to reduce public cost for major street improvement through coordination with private action; to enable private interests to plan their actions, improvements, and development with full knowledge of public interest; to minimize disruption and displacement of people and business; to reduce transportation environmental impacts; and to increase travel safety.

This report documents the thoroughfare planning study process and related social and environmental issues. Section II contains a set of principles on which a typical thoroughfare plan is based and Section III contains a description and analysis of existing conditions in the Sandhills Area that have a bearing on the thoroughfare plan. Section IV consists of a discription of the different alternative road networks which were analized in the study and Section V contains an analysis of those networks based on their environmental impact on the area. Section VI has the list of final recommendations for the new thoroughafare plan and Section VII contains a description of ways to implement those recommendations.

II. THOROUGHFARE PLANNING PRINCIPLES

Typically, the urban street system occupies 25 to 30 percent of the total developed land in an 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 public officials use to assure the development of the most appropriate street system that will meet existing and future travel desires within the urban area.

The primary aim of a thoroughfare plan is to guide the development of the urban street system in a manner consistent with changing traffic so errors and much needless expense can be averted. A thoroughfare plan will enable street improvements to be made as traffic demands increase, and help eliminate unnecessary improvements. By developing an urban street system that can keep pace with increasing traffic demands, a maximum utilization of the system can be attained that will require a minimum amount of land for street purposes. In addition to providing for traffic needs 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, commercial, and industrial enterprises affects major street and highway locations. Conversely, the location of major streets and highways within the urban area will influence the urban development pattern.

Other objectives of a thoroughfare plan include:

1. To provide for the orderly development of an adequate major street system as land development occurs;

2. To reduce travel and transportation costs;

3. To reduce the cost of major street improvements to the public through the coordination of the street system with private action;

4. to enable private interests to plan their actions, improvements, and development with full knowledge of public intent;

5. To minimize disruption and displacement of people and businesses through long range advance planning for major street improvements;

6. To reduce environmental impacts such as air pollution resulting from transportation;

7. To increase travel safety.

Thoroughfare planning objectives are achieved through both:

1. improving the operational efficiency of thoroughfares;

2. improving the system efficiency through system coordination and layout.

A. OPERATIONAL EFFICIENCY

A street's operational efficiency is improved by increasing the capability of the street to carry vehicular traffic and people. In terms of vehicular traffic, a street's capacity is defined as the maximum number of vehicles which can pass a given point on a roadway during a given time period under prevailing roadway and traffic conditions. Capacity is affected by the physical features of the roadway, the nature of the traffic, and the weather.

Physical ways to improve vehicular capacity include street widening, intersection improvements, improving vertical and horizontal alignment, and eliminating roadside obstacles. For example, widening of a street from two to four lanes more than doubles the capacity of the street by providing additional maneuverability for traffic. Impedances to traffic flow caused by slow moving or turning vehicles and adverse effects of horizontal and vertical alignments are thus reduced.

Operational ways to improve street capacity include:

1. Control of access--A roadway with complete access control can often carry three times the traffic handled by a non-controlled access street with identical lane width and number.

2. Parking removal--Increases capacity by providing additional street width for traffic flow and reducing friction to flow caused by parking and unparking vehicles.

3. One-way operation--The capacity of a street can sometimes be increased 20-50%, depending upon turning movements and overall street width, by initiating one-way traffic operations. One-way streets can also improve traffic flow by decreasing potential traffic conflicts and simplifying traffic signal coordination.

4. Reversible lanes--Reversible traffic lanes may be used to increase street capacity in situations where heavy directional flows occur during peak periods.

5. Signal phasing and coordination--Uncoordinated signals and poor signal phasing restricts traffic flow by creating excessive stop-and-go operation.

Altering travel demand is a third way to improve the efficiency of existing streets. Travel demand can be reduced or altered in the following ways:

1. Encourage people to form carpools and vanpools for journeys to work and other trip purposes. This reduces the number of vehicles on the roadway and raises the people-carrying capability of the street system.

2. Encourage the use of transit and the bicycle mode.

3. Encourage industries, businesses, and institutions to

stagger work hours or establish variable work hours for employees. This will reduce travel demand in peak periods and spread peak travel over a longer time period.

4. Plan and encourage land use development or redevelopment in a more travel efficient manner such as the use of multiple entrances to planned residential developments.

B. SYSTEM EFFICIENCY

Another means for altering travel demand is the development of a more efficient system of streets that will better serve travel desires. A more efficient system can reduce travel distances, time, and cost. Improvements in system efficiency can be achieved through the concept of functional classification of streets and development of a coordinated major street system.

1. FUNCTIONAL CLASSIFICATION

Streets perform two primary functions-- traffic service and land service, which when combined, are basically incompatible. The conflict is not serious if both traffic and land service demands are low. However, when traffic volumes are high, conflicts created by uncontrolled and intensely-used abutting property lead to intolerable traffic flow friction and congestion.

The underlying concept of the thoroughfare plan is that it provides a functional system of streets which permits travel from origins to destinations with directness, ease, and safety. Different streets in the system are designed and called on to perform specific functions, thus minimizing the traffic and land service conflicts. Streets are categorized as to function as local access streets, minor thoroughfares, or major thoroughfares.

Local access streets provide access to abutting property. They are not intended to carry heavy volumes of traffic and should be located such that only traffic with origins and destinations of the streets would be served. Local streets may be further classified as either residential, commercial, and/or industrial depending upon the type of land use which thy serve.

Minor thoroughfares are more important streets on the city system. They collect traffic from local access streets and carry it to the major thoroughfare system. They may in some instances supplement the major thoroughfare system by facilitating minor through traffic movements. A third function is to provide access to abutting property. They should be designed to serve limited areas so that their development as major thoroughfares will be prevented.

Major thoroughfares are the primary traffic arteries of the city. Their function is to move intra-city and inter-city traffic. The streets which comprise the major thoroughfare system may also serve abutting property, however, their function is to carry traffic. They should not be bordered by uncontrolled strip development because such development significantly lowers the capacity of the thoroughfare to carry traffic and each driveway is

a danger and an impediment to traffic flow. Major thoroughfares may range from a two-lane street carrying minor traffic volumes to major expressways with four or more traffic lanes. Parking normally should not be permitted on major thoroughfares.

2. IDEALIZED THOROUGHFARE PLAN SYSTEM

A coordinated system of major thoroughfares forms the basic framework of the urban street system. A major thoroughfare system which is most adaptable to desired lines of travel within an urban area and which permits movement between various areas of the city within maximum directness is the radial-loop system. This system consists of several functional elements--radial streets, crosstown streets, loop system streets, and bypasses.

Radial streets provide for traffic movement between points located on the outskirts of the city and the central area. This is a major traffic movement in most cities, and the economic strength of the central business district depends upon the adequacy of this type of thoroughfare.

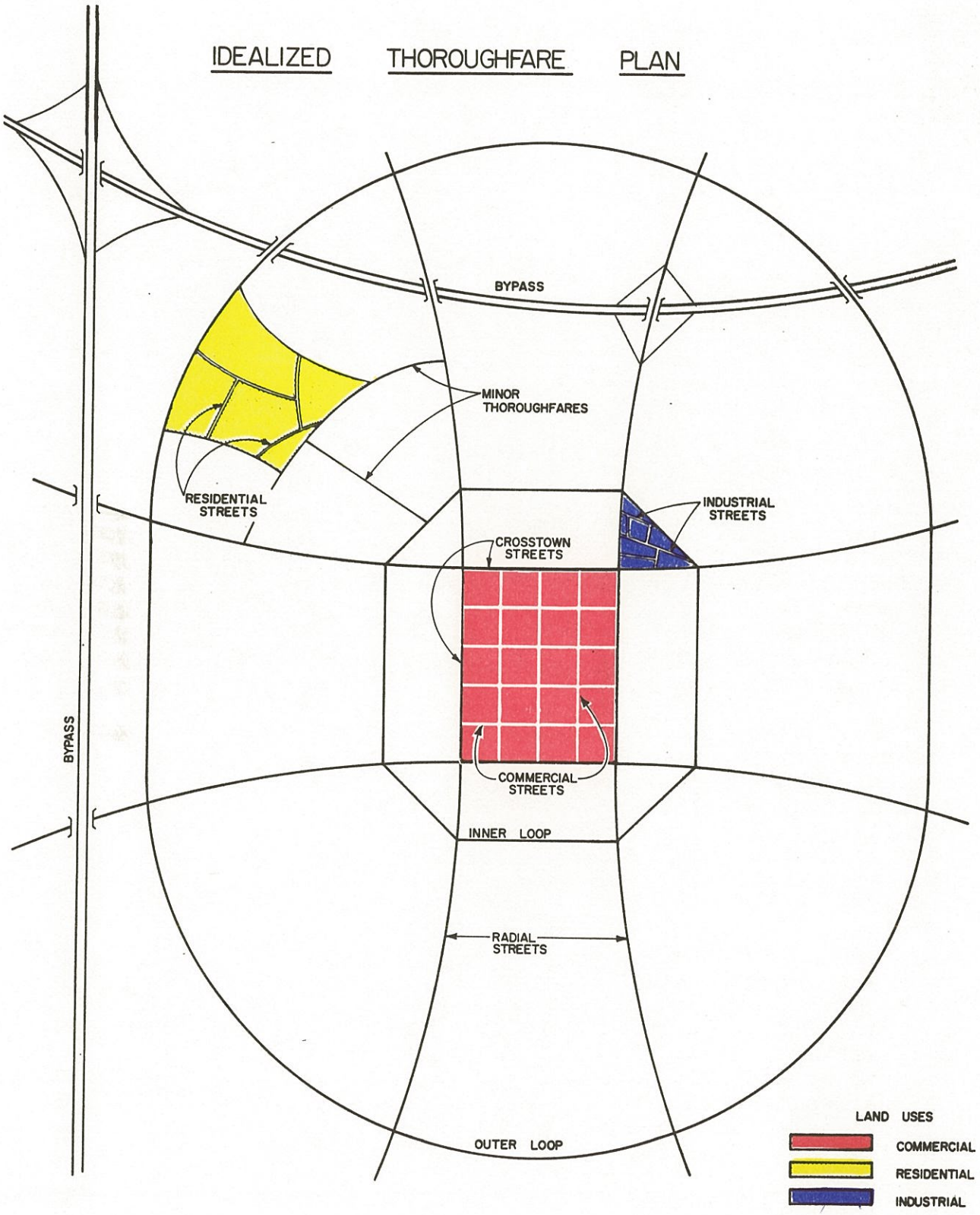
If all radial streets crossed in the central area, an intolerable congestion problem would result. To avoid this problem, it is very important to have a system of crosstown streets which form a loop around the central business district. This system allows traffic moving from origins on one side of the central area to destinations on the other to follow the area's border and allows central area traffic to circle and then enter the area near a given destination. The effect of a good crosstown system is to free the central area of crosstown traffic, thus permitting the central area to function more adequately in its role as a pedestrian shopping area.

Loop system streets move traffic between suburban areas of the city. Although a loop may completely encircle the city, a typical trip may be from an origin near a radial thoroughfare to a destination near another radial thoroughfare. Loop streets do not necessarily carry heavy volumes of traffic, but they function to help relieve central areas. There may be one or more loops, depending on the size of the urban area, and they are generally spaced one-half mile to one mile apart, depending on the intensity of land use.

A bypass is designed to carry traffic through or around the urban area, thus providing relief to the city street system by removing from it traffic which has no desire to be in the city. Bypasses are usually designed to through-highway standards, with control of access. Occasionally, a bypass with low traffic volume can be designed to function as a portion of an urban loop. The general effect of bypasses is to expedite the movement of through traffic and to improve traffic conditions within the city. By freeing the local streets for use by shopping and home-to-work traffic, bypasses tend to increase the economic vitality of the local area.

An idealized thoroughfare plan showing the described facilities is in Figure II-1.

FIGURE II-1


IDEALIZED THOROUGHFARE PLAN
BYPASS
MINOR THOROUGHFARES
RESIDENTIAL STREETS
INDUSTRIAL STREETS
CROSSTOWN STREETS
BYPASS
COMMERCIAL STREETS
INNER LOOP
RADIAL STREETS
OUTER LOOP
LAND USES
COMMERCIAL
RESIDENTIAL
INDUSTRIAL

C. APPLICATION OF THOROUGHFARE PLANNING PRINCIPLES

The concepts presented in the discussion of operational efficiency, functional classification, and idealized major thoroughfare system are the conceptual tools available to the transportation planner in developing a thoroughfare plan. In actual practice, thoroughfare planning is done for established urban areas and is constrained by the existing land use and street patterns, existing public attitudes and goals, and current expectations of future land use. Compromises must be made because of these and the many other factors that affect major street locations.

III. EXISTING AND PROJECTED CONDITIONS

A. TRAVEL TRENDS

The amount and character of travel in an area is directly related to the condition of the existing transportation network, the population, use of the land and the economic conditions there. To define the quality of travel in the area as it exists today and to have some basis for determining future travel conditions a survey of the population, land use, economy, condition of the environment, and the road network in the area must be made.

Once the existing or base year characteristics are determined those same characteristics must be projected to the future for planning purposes. The usual planning period is about twenty years. The planning period for this study was 23 years--from 1987 to 2010.

The current method of analyzing the surveyed information is by computer modeling. One way to facilitate the efficient and accurate collection, projection, and analysis of the collected socio-economic data is to define an area for study and then divide it into smaller areas or zones of similar land use composition to survey. This planning area has 115 zones. A detailed explanation of the modeling process is in Appendix A.

B. POPULATION TRENDS

The travel in an area is directly related to the population in that area. Table III-1 shows historic population totals for the Sandhills and related areas.

TABLE III-1
POPULATION TRENDS

	1960	1970	1980	1989*
Pinehurst	1,124	1,056	1,622	3,062
Aberdeen	1,532	1,592	1,945	2,766
Mineral Spr Twnshp	5,419	5,092	8,007	N/A
Southern Pines	5,198	5,937	8,620	10,457
Sandhill Twnshp	5,476	6,442	9,240	N/A
McNeills Twnshp	8,895	10,221	13,960	N/A
Moore County	36,733	39,048	50,505	62,200

* Office of State Budget, US Bureau of Census and Moore County

Also important is where and in what manner that population is distributed throughout the planning area. The estimated base population for the planning area was 23,158. This number was based on the number of dwelling units counted multiplied by an average number of persons per dwelling unit. Likewise the design year population was estimated at 85,507. The base year survey found 9,654 dwelling units in the planning area and with the aid of the local planners 19,127 dwelling units were estimated for the design year.

These dwelling units were stratified into categories based on the estimated number of trips the dwellers would contribute to the travel in the whole system. The categories were Excellent, Above Average, Average, Below Average, Poor, and Special trip generators. The distribution of dwelling units in each traffic zone in the planning area is explained in Appendix A.

C. LAND USE TRENDS

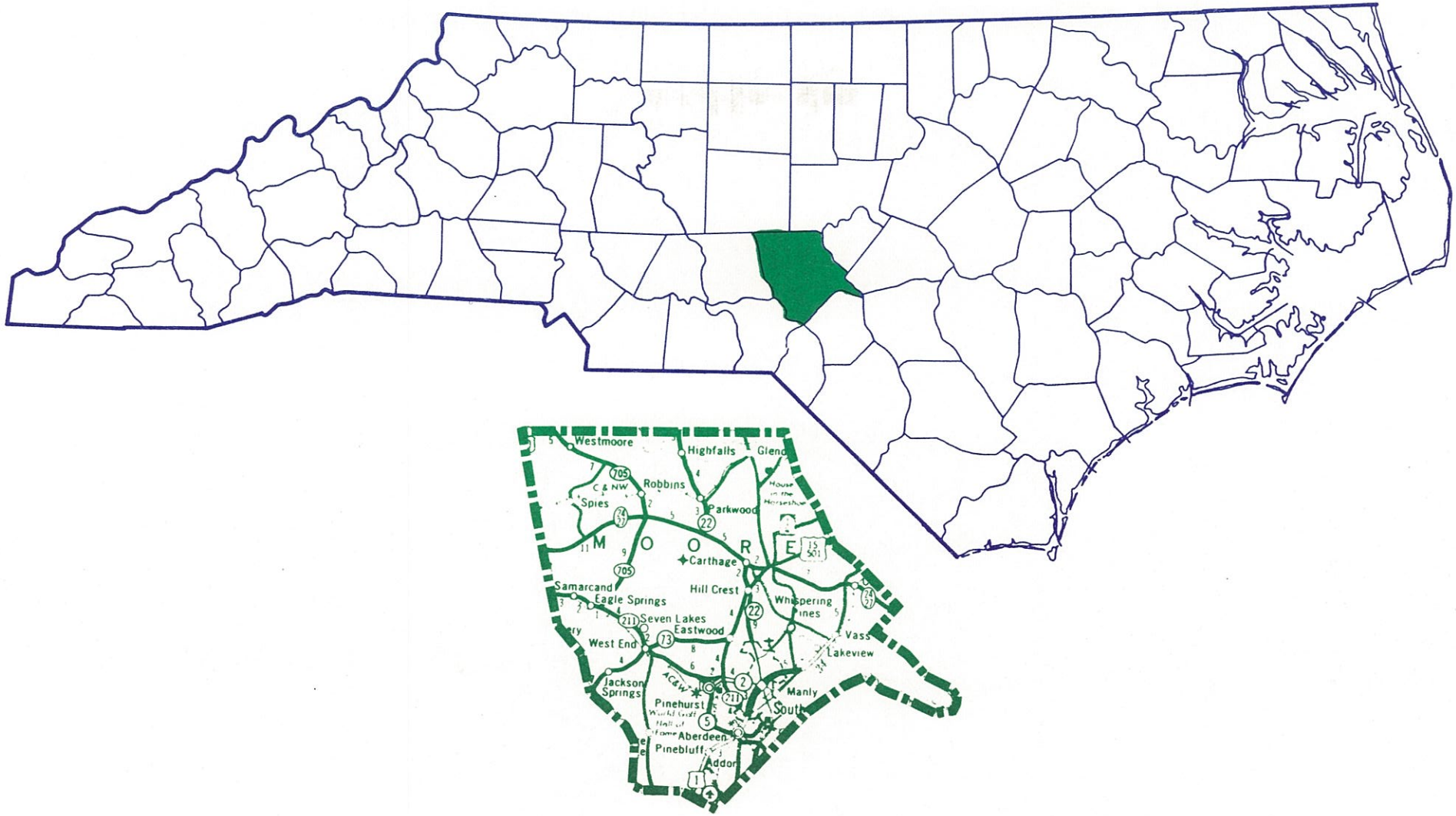
The generation of traffic on a particular street is closely related to the land uses of the adjacent property on that street. Some types of land uses generate more trips than others. Also some land uses attract more trips than others based on the intensity and spatial separation of those developments. For example, a shopping center generates larger traffic volumes than a residential area. Therefore, it is important in transportation planning to differentiate land use types so their present and future distribution throughout the planning area can be used to determine existing and future traffic patterns.

There are several basic variables used to forecast future land development. Some of them are: anticipated population changes; historical trends in the different types of development; the availability and effectiveness of legal controls, regulations, and ordinances; the availability of utility and transportation facilities; and major topographic or other environmental features.

Southern Pines has a current land use plan. Aberdeen, too, has done land use planning. Pinehurst has recently adopted a plan. Other land use information was obtained by the field survey of the area. Figure III-1 show the
Geographic Location of these towns.

Figures III-2 and III-3 show existing and anticipated land uses in the planning area. There is quite a bit of land in use for recreational purposes in both the public and private sector. Golf is a major pastime in the Sandhills. The Sandhills is also horse country. There are several horse farms east of Southern Pines. Commercial property is located mainly along US 1 in Aberdeen and Southern Pines in strip shopping centers with a centrally located mall and smaller centers distributed throughout the area. There is some industry located mostly in Southern Pines east of Yadkin Road and in Aberdeen along NC 5 and south of town. There is virtually no industry or commercial property in Pinehurst other than the several golf courses in keeping with its recreational and residential atmosphere.

There are no anticipated major changes in land uses in the area, only more of the same as property is developed. Southern Pines plans an industrial park area east of Yadkin Road and commercial development near the airport. Aberdeen expects more ndustrial and commercial development south of town along US 15-501 and NC 211. In Pinehurst most new development will be residential and recreational in nature. Taylortown plans more commercial development along NC 211.



SOUTHERN PINES
-ABERDEEN
-PINEHURST

GEOGRAPHIC LOCATION

FIGURE III-1

FIGURE III-2

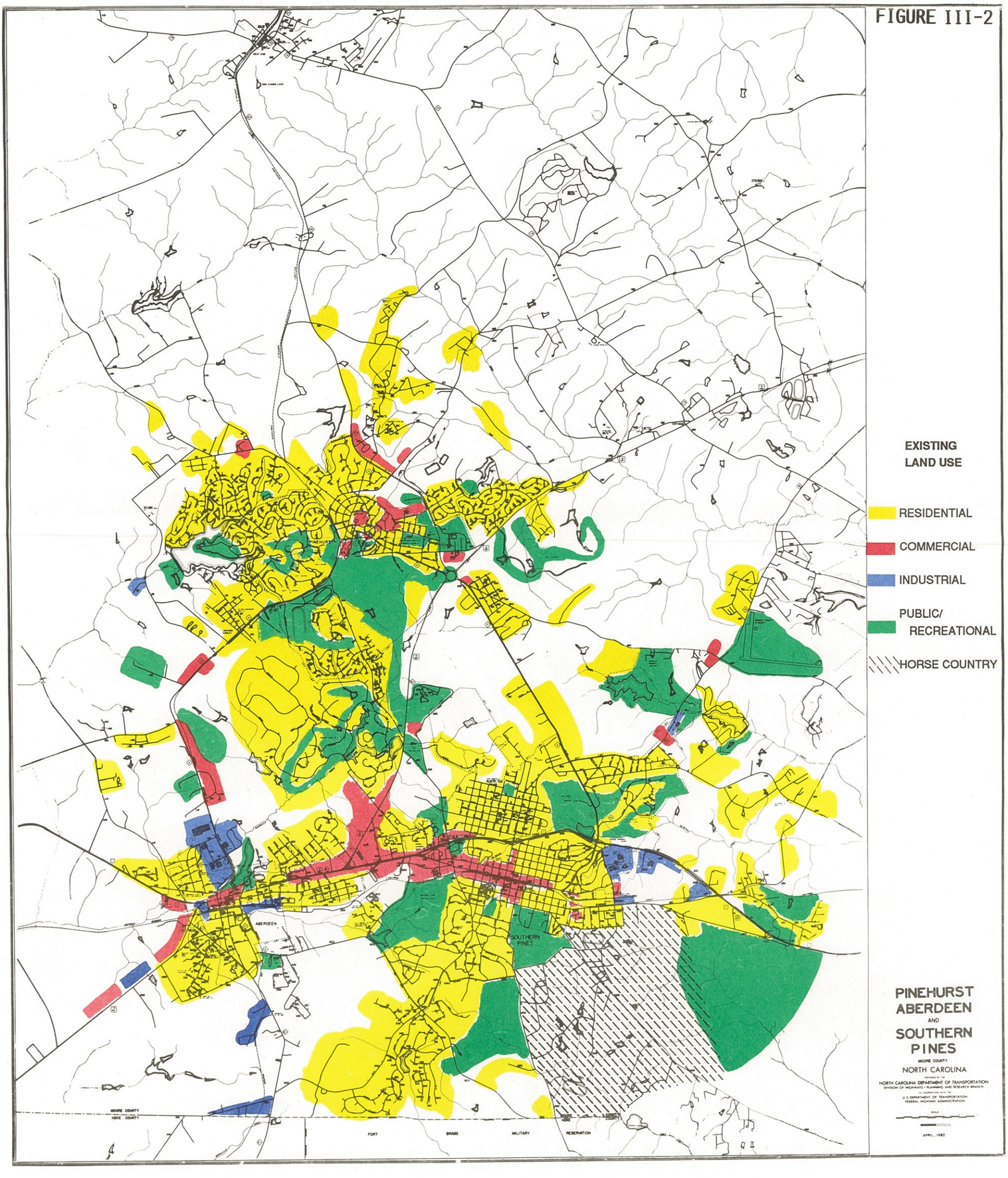
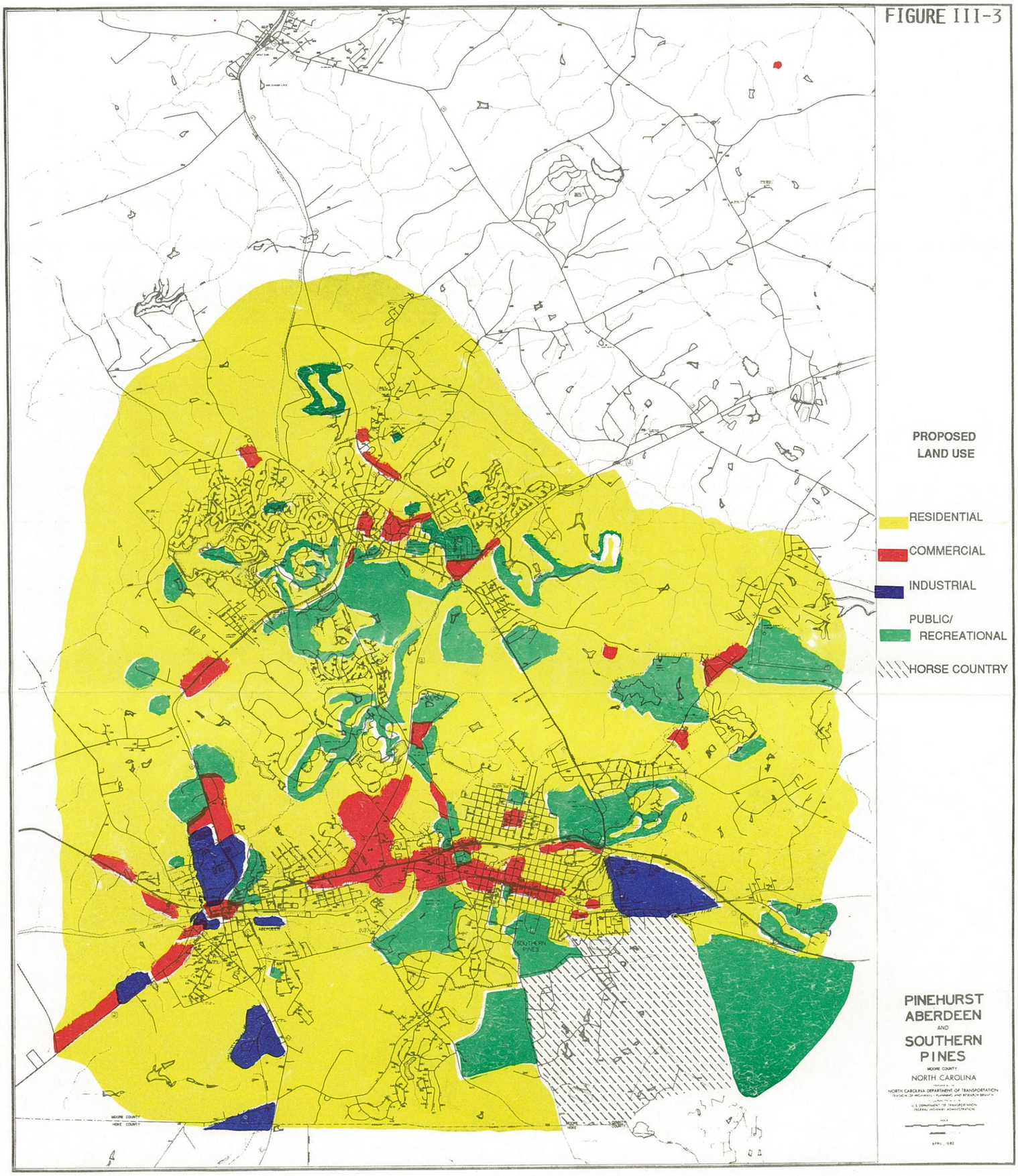

EXISTING
LAND USE
RESIDENTIAL
COMMERCIAL
INDUSTRIAL
PUBLIC/
RECREATIONAL
HORSE COUNTRY
PINEHURST
ABERDEEN
AND
SOUTHERN
PINES
MOORE COUNTY
NORTH CAROLINA
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - PLANNING AND RESEARCH BRANCH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
APRIL, 1982
ABERDEEN
SOUTHERN
PINES
MOORE COUNTY
HOKE COUNTY
FORT
BRAGG
MILITARY
RESERVATION

FIGURE III-3


PROPOSED
LAND USE
RESIDENTIAL
COMMERCIAL
INDUSTRIAL
PUBLIC/
RECREATIONAL
HORSE COUNTRY
PINEHURST
ABERDEEN
AND
SOUTHERN
PINES
MOORE COUNTY
NORTH CAROLINA
APRIL, 1982

D. ECONOMIC TRENDS

The region is surrounded by several major cities--Fayetteville, forty-one miles east; Laurinburg, thirty-two miles south; Rockingham, thirty miles southwest; Asheboro, fifty-two miles northwest; Chapel Hill, fifty-one miles north; and Sanford, twenty-seven miles northeast. This location makes the Sandhills region accessable to several major markets. The amount of employment available and amount of employee purchasing power determine how large an economic base an area can support. In 1987 there were an estimated 12,885 people employed inside the planning area giving an employment-to-population ratio of 56%. Employment data by industry groups for the planning area is listed in Appendix A.

Purchasing power of a family is related to the income of that family. The median family income for North Carolina in 1969 was $7,774. In 1989 it was $30,200. Likewise, the median family income in Moore County rose from $6,824 to $29,000. Table III-2 shows the relationship between various municipal entities.

TABLE III-2
MEDIAN FAMILY INCOME

	1969	1979	1989*
United States	$ --	--	34,000
North Carolina	7,774	--	30,200
Moore County	6,824	16,779	29,000
Southern Pines	6,547	17,208	--
Pinehurst	--	22,739	--

*Office of State Budget and Management

E. LOCAL GOALS AND OBJECTIVES

Thoroughfare Plan Objectives

To aid in the evaluation of alternative thoroughfare plans, one hundred objective surveys were distributed to citizens in the Southern Pines-Aberdeen-Pinehurst area. Approximately one third of the surveys were completed and returned. In the survey individuals were asked to evaluate thirty five items on a scale of Not Desirable to Most Desirable.

Not Desirable	Neutral	Desirable	Very Desirable	Most Desirable
(-1)	(0)	(1)	(2)	(3)

The responses were assigned a numerical value from (-1) to (3) as shown. The results were then tabulated and ranked according to the overall weighted average. The Table III-3 is given below.

Limiting of commercial signs and traffic safety were found to be the most desirable objectives for a thoroughfare plan. Landscaping along streets, land use zoning and improved traffic flow at intersections were also considered very desirable. These and other highly ranked objectives indicate that the aesthetics of the transportation system are very important to the Southern Pines-Aberdeen-Pinehurst area. This assumption is also supported by the fact that strip commercial development was ranked as the least desirable objective. Some of the other undesirable or neutral objectives included bus transit and taxi service as well as one way streets and parking on heavily traveled streets.

TABLE III-3
RELATIVE DESIRABILITY
OF OBJECTIVES

RANK		VALUE
1	Limiting of commercial signs	2.67
2	Traffic Safety	2.58
3	Landscaping along streets	2.49
4	Land use zoning	2.47
5	Improved traffic flow at intersections	2.45
6	Attractive roads and bridges	2.41
7	Scenic travelways	2.24
8	City control of land subdivision	2.15
9	Special routes for trucks	2.00
10	Restrict access on major thoroughfares	2.00
11	Preservation of historic buildings	1.97
12	Parks and playgrounds	1.82
13	Access to industry and shopping centers	1.66
14	Access to central business area	1.63
15	School travel	1.59
16	Improve conditions at RR crossings	1.59
17	Travel time	1.55
18	Neighborhoods	1.55
19	Access to homes	1.39
20	Off street loading areas for trucks	1.34
21	Home to work travel	1.30
22	Construction costs of transp. system	1.18
23	Noise caused by vehicles	1.17
24	Sidewalks	1.00
25	Urban renewal	0.94
26	Cost of travel	0.87
27	Bicycle travel	0.82
28	Air pollution from vehicles	0.82
29	Bicycle routes	0.82
30	Improve transp. system to attract industry	0.47
31	One way streets	0.35
32	Parking on heavily traveled streets	0.18
33	Taxi service	0.15
34	Bus transit	-0.06
35	Strip commercial development	-0.36

F. EXISTING MAJOR STREET SYSTEM

The several towns in the Sandhills region were once only isolated settlements and have each developed their own town center, mainly around the railroad and station located there. Southern Pines began with a grid system with Broad Street as the main drag. Aberdeen, too, started with a network of streets parallel and perpendicular to the railroad tracks. Pinehurst does have a train station, but its circular system was planned around the Village's major attraction--The Pinehurst Hotel. Taylortown, more recently, has spread out in all directions along a major local street.

Five major roads connected the small towns and were once rural country roads or highways. Their character has greatly changed over the years and they are now merely major crosstown thoroughfares connecting the three major town centers. They are also the most heavily traveled roads in the planning area. They are NC 5, Morganton Road, US 15-501-NC 211, NC 2, and US 1 or Sandhills Boulevard.

Radiating out into the countryside from each town several major roads bring travel and trade into and through the region. They are NC 211 North, US 15-501 North, Airport Road, NC 22, US 1 North, NC 211 South, US 15-501 South, and US 1 South.

Figure III-4 shows the existing major street system.

G. HIGH ACCIDENT LOCATIONS

Since reducing the risk of traffic accidents is a major goal in any thoroughfare plan, accident reports for the Pinehurst, Aberdeen and Southern Pines area were studied for a three year period from January 1, 1985 to December 31, 1987. Intersections with a high number of accidents, ten or more, are listed in Table III-4. Several of the high accident locations are along Sandhills Boulevard, Morganton Road, and May Street. The intersection of US1 and NC 5 had the highest incidence of accidents with 33, mainly during left turns across traffic. Several places show a high rate of rear ending. They are places of frequent stop-start and weaving maneuvers like the traffic circle or along May where there is parking along the street. Any recommendations or improvements should address the potential for improved safety at these locations.

H. SYSTEM DEFICIENCIES

Several things contribute to the inefficient movement of traffic through this area. Six primary routes--US 1, US 15-501, NC 2, NC 5, NC 22, and NC 211--converge on these towns. NC 2 and NC 5 dump traffic into the four central business districts. US 1, US 15-501 and NC 211 use Sandhills Blvd. Through traffic must then deal with local traffic.

The roads between the three larger towns form a triangle with a cross in the middle. But, there is no parallel to the bottom side, US 1. That makes travel between places like the airport and the county landfill difficult.

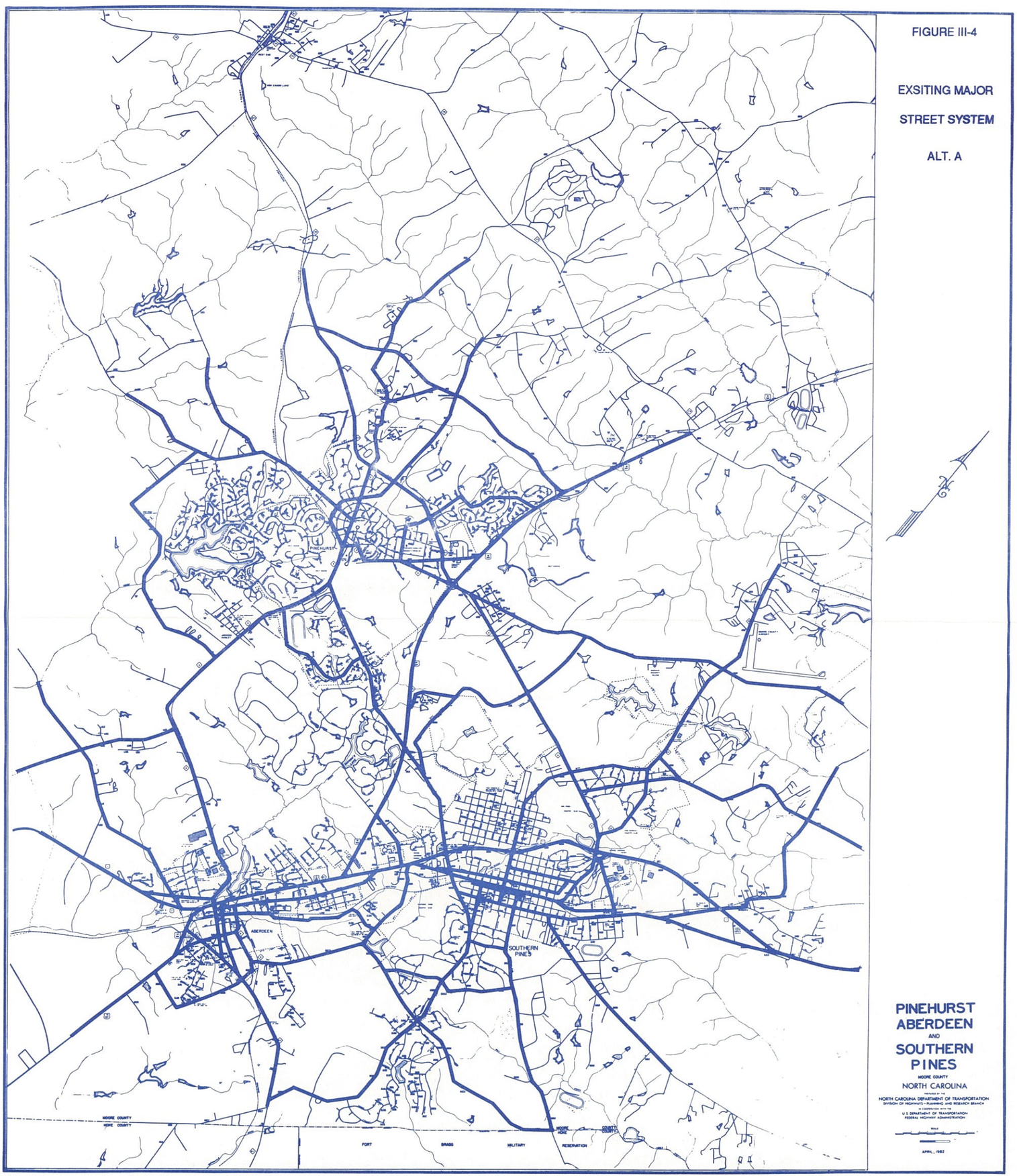


FIGURE III-4

EXSITING MAJOR STREET SYSTEM

ALT. A

PINEHURST
ABERDEEN
AND
SOUTHERN PINES

MOORE COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - PLANNING AND RESEARCH BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALE

APRIL, 1982

TABLE III-4
HIGH ACCIDENT INTERSECTIONS
January 1, 1985 - December 31, 1987

Location	Total no. Accidents	Serious Injuries	Predominant Location Accident Type
US 1 & NC 5	33	2	Lt cross traffic(12) Rear end turn(11)
US 1 & Johnson	27	0	Backing(12) Rear end turn(5)
Traffic Circle	26	0	Rear end turn(22)
US 15-501 & Johnson	24	3	Backing(9) Lt cross traffic(7)
US 1 & US 15-501	23	4	Rear end turn(8) Lt cross traffic(5)
Conn & May	22	4	Backing(14)
US 1 & Pinehurst	20	1	Rear end turn(6) Lt cross traffic(6)
US 1 & Magnolia	19	5	Rear end turn(11) Rt same rdwy (4)
Indiana & May	18	1*	Backing(10)
Broad & Morganton	14	1	Rear end turn(3) Lt cross traffic(3)
NC 22 & Airport Rd.	13	1	Backing(10)
US 1 & Saunders	11	1	Rear end turn(6)
US 15-501 & Pinehurst	11	0	Rear end turn(5)
Broad & NY	11	0	Parked vehicle(2) Angle(2) Other vehicle(2)
May & Vermont	11	1	Backing(6)
US1 & Morganton	10	2	Backing(3) Rear end turn(3)
US 1 & Murray Hill	10	0	Rear end turn(3) Lt cross traffic(3)
Bennett & Morganton	10	1	Backing(7)
Central & Midland	10	1	Backing(6)

***fatal accident**

IV. THOROUGHFARE PLAN ALTERNATIVES

Three alternatives are presented here. Alternate A consists of the existing major street network with no new facilities constructed. Alternate B is the existing 1977 Thoroughfare Plan. Alternate C is a suggested alternative presented to the local governing boards for their approval.

The system networks for three alternative plans were run through a volume-capacity analysis. The traffic capacities of each alternative network were then compared to the estimated 2010 traffic volumes to determine the feasibility of those alternates. The results of those comparisons are found in the following sections.

A. NO BUILD ALTERNATIVE

This first alternative consists of the existing major street network with the projected 2010 traffic on it. The network appears in figure III-4. Alternative A is useful to illustrate expected future locations of capacity deficiency if no new facilities are constructed within the system. This is essentially a "do-nothing" alternative. Some advantages of doing nothing are:

1. No capital investment.
2. No construction traffic disruption.
3. No air, water or noise pollution due to construction.
4. No removal of shrubs or trees.
5. No additional land acquisition.
6. No displacement of people or businesses as a result of construction.

Conversely there are also disadvantages to doing nothing, such as:

1. Increased traffic volumes and congestion on major streets which will cause traffic to divert to residential streets.
2. Existing "bottleneck" situations will become worse.
3. Social, health, and safety standards will deteriorate.
4. Increased road use costs.
5. Increased driving time.
6. Increased accidents.
7. Increased air and noise pollution induced by traffic congestion.
8. Reduced mobility for emergency vehicles.
9. Increased transportation costs for businesses.
10. Reduced retail sales as a result of increased congestion, reduced accessibility, and higher transportation costs.
11. Increased driver and public frustration due to congestion.

The costs incurred by this plan would be those associated with the standard maintenance and widening schedule and possible low-cost non-construction improvements to the existing street system.

Several possible operational improvements include:

controlling access on thoroughfares; eliminating on street parking on certain streets; one-way traffic operations; reversible traffic lanes; and improvements in traffic signal phasing and co-ordination. Altering travel demand would include: measures to increase vehicle occupancy and the use of alternate modes of travel; staggering work hours; altering land use development patterns; and restrictions on urban growth.

Several stretches of road would have to be widened if this alternative were chosen. They are:

Airport Road from Knoll Road to the College
Buelah Hill Road from Morganton Road to Linden Road
Morganton Road from Montecello Road to US 1
NC 5 from Montecello to US 1
NC 22 from the Reservoir to Pee Dee Road
NC 211 north from the study boundary to the Circle
US 15-501 from Raeford Road to the study boundary
NC 211 south from Old Peedee Road to the study boundary
Sandhills Boulevard from NC 5 to US 15-501
US 15-501 from the Circle to Sandhills Boulevard

B. EXISTING THOROUGHFARE PLAN

This alternative consists of the 1974 or "old" thoroughfare plan with the projected 2010 traffic on it and is shown in Figure IV-1. Several new facilities would be built, such as:

A western bypass of Pinehurst from NC 211 to NC 5
A Linden Road-Richmond Street Connector
A McKenzie Road-Kelly Road Connector
A Gun Club Road-Murdocksville Road Connector
A Knoll Road Extension across US 15-501 to Murdocksville Road
A Montecello Road Extension across US 15-501 to Midland Road
A western Sandhills Boulevard bypass from US 1 to Pee Dee Rd.
An eastern Aberdeen bypass from US 15-501 to NC 211 south
A Sycamore Street-Broad St Connector
An industrial park road between Yadkin Road and US 1
A NC 5-Sandhills Boulevard Connector
A Bethesda Road-Old Peedee Road Connector

In addition to the new facilities these streets would be widened under this plan:

Airport Road from Knoll Road to the College
Azalea Road from Cherokee Road to Palmetto Road
Central Drive from Midland Road to Pee Dee Road
Cherokee Road from Beulah Hill Road to Azalea Road
Midland Road from Pee Dee Road to Central Drive
Morganton Rd from Montecello Rd to US 1
NC 5 from Montecello Road to Sandhills Boulevard
NC 22 from Pee Dee Road to the Airport
NC 211 from Rattlesnake Trail to the Circle
Palmetto Road from Azalea Road to Kelly Road
US 15-501 south from Raeford Road to the study boundary
NC 211 south from Old Peedee Road to the study boundary
Roseland Road from Needham Grove Road to US 1
Sandhills Boulevard from NC 5 to Broad Street

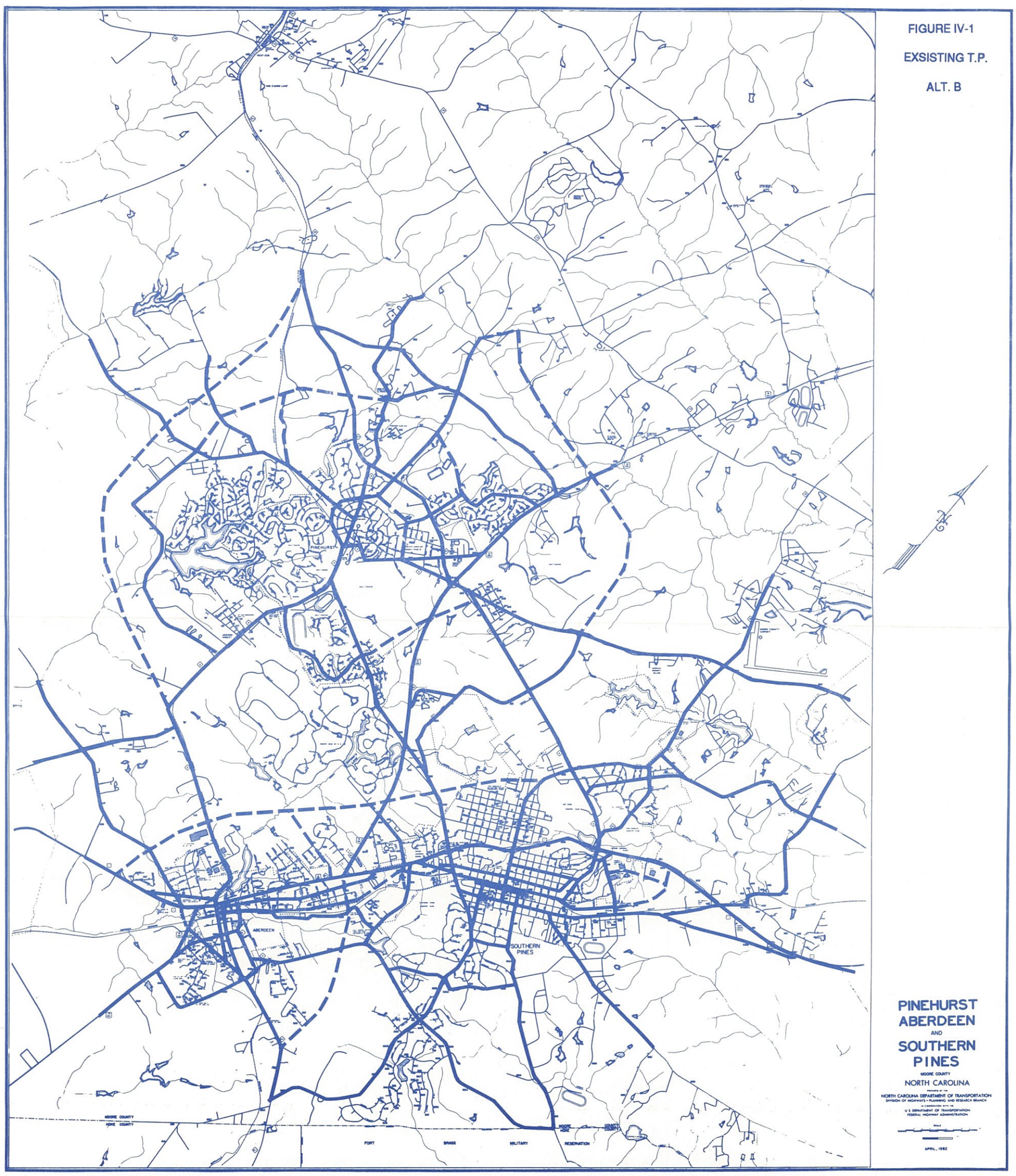


FIGURE IV-1

EXSISTING T.P.

ALT. B

PINEHURST
ABERDEEN
AND
SOUTHERN PINES

MOORE COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - PLANNING AND RESEARCH BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APRIL, 1982

US 15-501 from the Circle to Murray HIll Avenue
Needham Grove Road from Roseland Road to NC 5

C. RECOMMENDED ALTERNATIVE

This final alternative is a modification of the 1974 Thoroughfare Plan. It is shown in Figure IV-3. Several facilities on new location were removed from the old plan. They are:

A Linden Road-Richmond Street Connector
A McKenzie Road-Kelly Road Connector
A Gun Club Road-Murdocksville Road Connector
A road connecting US 15-501 and Murdocksville Road
A Montecello Road Extension across US 15-501 to Midland Road
A western Sandhills Boulevard bypass from US 1 to Pee Dee Rd.
A Sycamore Street-Broad St Connector
An industrial park road between Yadkin Road and US 1
A NC 5-Sandhills Boulevard Connector
A Bethesda Road-Old Peedee Road Connector

The alignments on these facilities were adjusted:

A western Pinehurst bypass from NC 211 to Roseland Road with a connection to NC 5 using Green Avenue
An eastern Aberdeen bypass from Saunders Boulevard to NC 211 south

In addition, these streets would be widened (see Appendix D):

Airport Road from NC 22 to Knoll Road
NC 22 and Central Drive from the Airport to Midland Road
Morganton Road from CCNC to Broad Street
Murry Hill Road from US 15-501 to Sandhills Blvd.
NC 5 from Linden Road South to Sandhills Blvd.
Poindexter Street from Raeford Road to US 15-501 south
Raeford Road from Poindexter street to NC 211 south
Roseland Road from the Bypass to Sandhills Blvd. with a bridge connection to Raeford Road
Sandhills Blvd from the Bypass to Broad Street
Saunders Blvd from Sandhills Blvd to Fort Bragg Road with an intersection relocation with Murray Hill Road
Yadkin Rd from May Street to US 1 ramps

Some minor thoroughfares would be removed from the Thoroughfare plan:

Montecello Road
Old Pee Dee Road
Main Street
Maple Street
Blue Street
Sycamore Street
Leak Street
Bennett Street
Fairview Road from NC 2 to NC 22

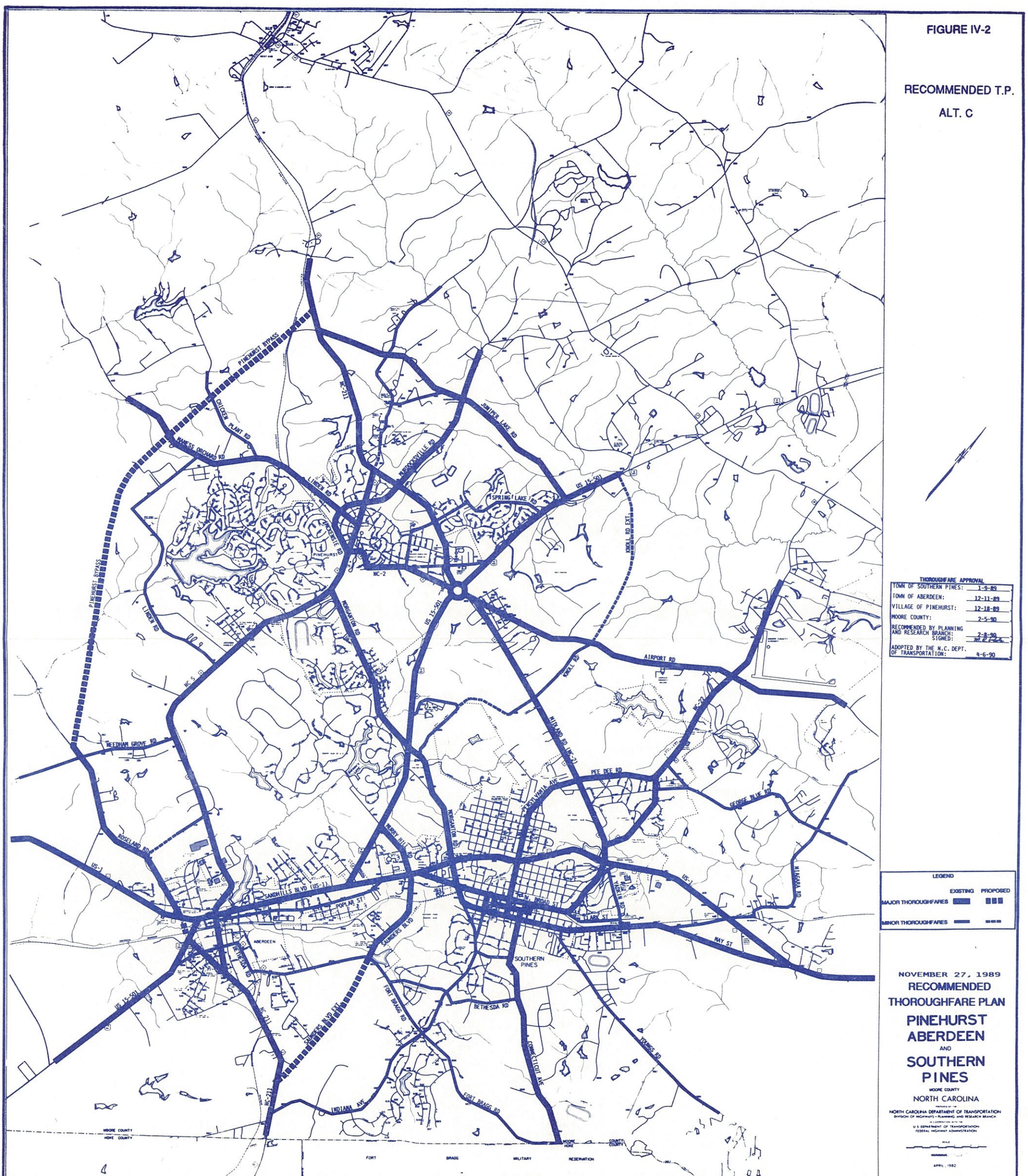


FIGURE IV-2

RECOMMENDED T.P.

ALT. C

THOROUGHFARE APPROVAL	
TOWN OF SOUTHERN PINES:	1-9-89
TOWN OF ABERDEEN:	12-11-89
VILLAGE OF PINEHURST:	12-18-89
MOORE COUNTY:	2-5-90
RECOMMENDED BY PLANNING AND RESEARCH BRANCH: SIGNED:	2-8-90
ADOPTED BY THE N.C. DEPT. OF TRANSPORTATION:	4-6-90

LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARES		
MINOR THOROUGHFARES		

NOVEMBER 27, 1989

RECOMMENDED THOROUGHFARE PLAN

PINEHURST ABERDEEN AND SOUTHERN PINES

MOORE COUNTY

NORTH CAROLINA

IN COOPERATION WITH THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - PLANNING AND RESEARCH BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALE

HORIZONTAL

VERTICAL

APRIL, 1982

V. EVALUATION OF ALTERNATIVES BASED ON THEIR EFFECT ON THE PHYSICAL, SOCIAL AND ECONOMIC ENVIRONMENT

Environmental awareness has had a great influence on transportation plan development. Any recommendations for improvements to the transportation network must consider their influence on both the natural and man-made environment. Each of the three alternative plans were evaluated according to their effect on the planning area's physical, social, and economic environment.

A. PHYSICAL ENVIRONMENT

1. AIR QUALITY

It has been found that use of the internal combustion engine in motor vehicles has caused approximately three-fourths of the arbon monoxide (CO), half the hydrocarbons (HC), and nearly half the nitrogen oxides (NO_X) in the atmosphere. Over the past twenty years there has been extensive research into methods to reduce these pollutants. The Federal Government is scheduled to pass an updated Air Quality Act in 1990 which will set higher standards on emissions for new automobiles.

The layout of the major street system will have an effect on air quality in the area. A street system that provides easy and direct movement between all sections of the city will reduce travel time and distances, thus reducing emissions. A thoroughfare plan designed to reduce congestion and stop-and-go driving conditions will also help reduce the concentration of pollutants in the air.

TABLE V-1
AIR QUALITY ANALYSIS OF ALTERNATIVE PLANS (KG)

Alternative	Daily VMT (mi)	Carbon Monoxide (CO)	Nitric Oxides (NO_X)	Hydro-Carbons (HC)
A	1109818	9433	4163	6155
B	1098233	9403	4201	6119
C	1094743	9508	4265	6174

2. WATER QUALITY

Water in the planning area drains into two different basins. The dividing line runs along NC 211 through Pinehurst and NC 2 and Youngs Road in Southern Pines. Streams north of that ridge drain into the Little River and those south drain into Drowning Creek. High floodplain areas exist along McDeeds Creek, Mill Creek, James Creek, Aberdeen Creek, Nicks Creek, Joes Fork Creek, and Horse Creek.

The quality of the water supply is one of an area's prime assets. The groundwater supply in Moore County is considered adequate for domestic purposes but varies according to the

geology. The best well locations are the low lying areas.

While vehicular traffic contributes to air pollution which may affect water quality the largest threat comes during construction. Strict guidelines and procedures must be followed to reduce erosion during and after construction of new facilities. Every effort should be made to preserve one of our most valuable natural resources. Obviously, the more construction there is the greater the threat of water pollution.

Alternative A involves about 21 crossings and the draining of one lake. Alternative B involves 44 crossings and four lakes. Alternative C involves 24 crossings and four lakes.

3. SOILS AND GEOLOGY

Soil quality is a critical factor in the construction of future roadways. Important characteristics are a soil's permeability, shrink-swell potential, the depth to bedrock and the flood potential.

Most of the southern half of Moore County is part of the Sandhills region of the Coastal Plain. The topography consists of gently rolling slopes. The dividing line between "clay country" and "sand country" runs along a line from Carthage to Samarcand. The predominant soil association in the Sandhills is Lakeland-Norfolk. Norfolk consists of several grades of sand--sand, course sand, loamy sand, and sandy loam. Also, because of considerable erosion, dispersed throughout the planning area are Hoffman sandy loam and gravely sandy loam, Kalmia sandy loam, and some swampy areas along the creeks. Impervious layers of clay are interspersed with the sand in some locations. The sandy soil is porous, has good percolation, and there is not much runoff. The soil conditions can present limitations on sewage systems and cause adverse building conditions.

Drainage along the roads is not much of a problem and road cross sections have been modified in many places to reflect that fact. The abundant sand, gravel, and clay also make good building material, but that material is also subject to erosion and care must be taken in design and construction to minimize the potential for erosion along a project.

4. WILDLIFE AND VEGETATION

The land in that part of the Little River basin in which the planning area lies is well suited for growing Bermuda grass pastureland for horses and cattle. The Drowning Creek basin growth is similar and is also suitable for commercial forestry. The soils typically need large amounts of fertilizer and irrigation for growing crops and are thus much better for development. Clearing an inordinate amount of vegetation, though, could lead to erosion of the open land.

The early settlers in the Sandhills area came because of the beauty and peacefulness of the pine forests. Amidst the recent growth in the area there are still places in which that early beauty can be found. Figure V-1 shows their approximate location.

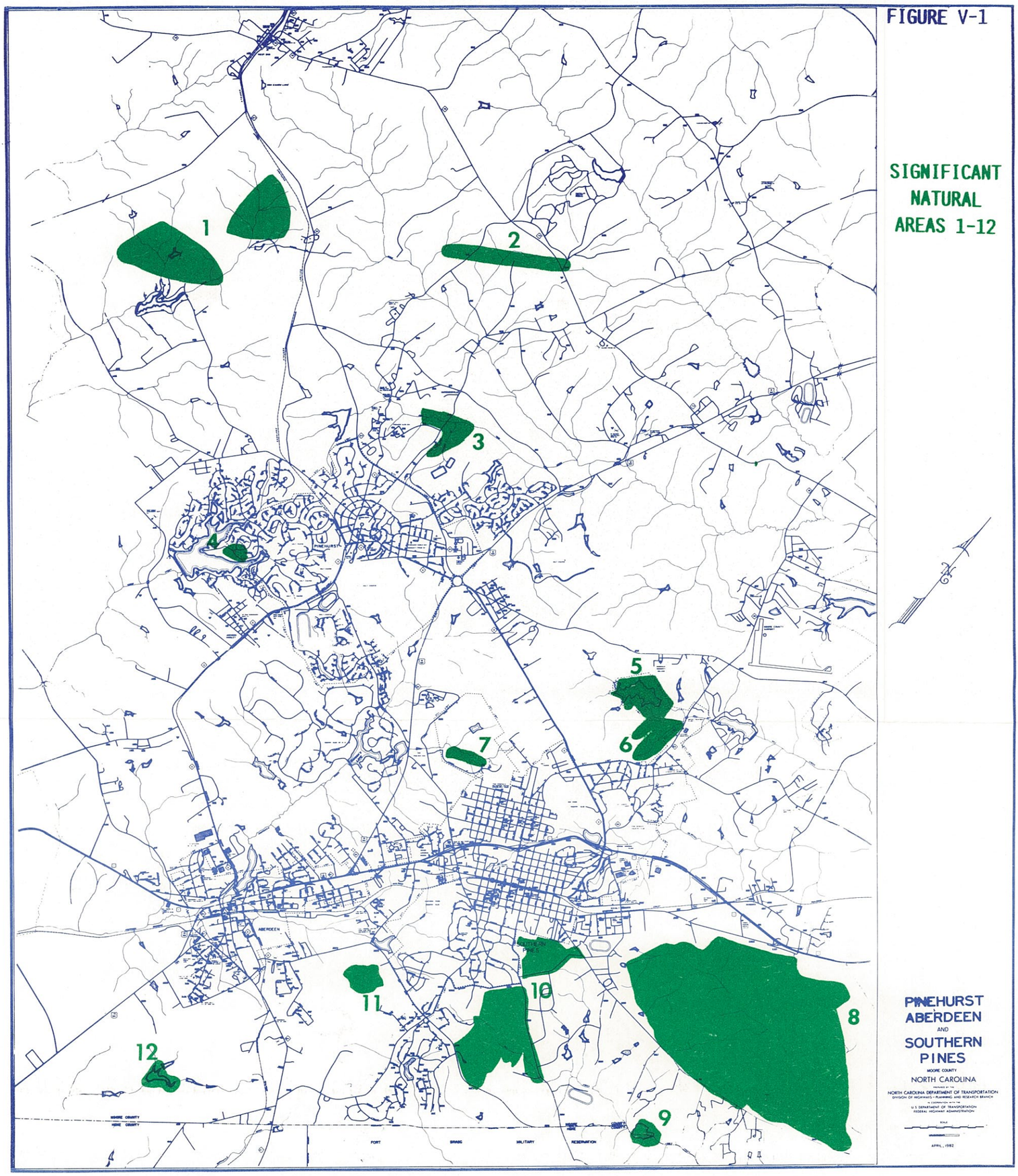


FIGURE V-1

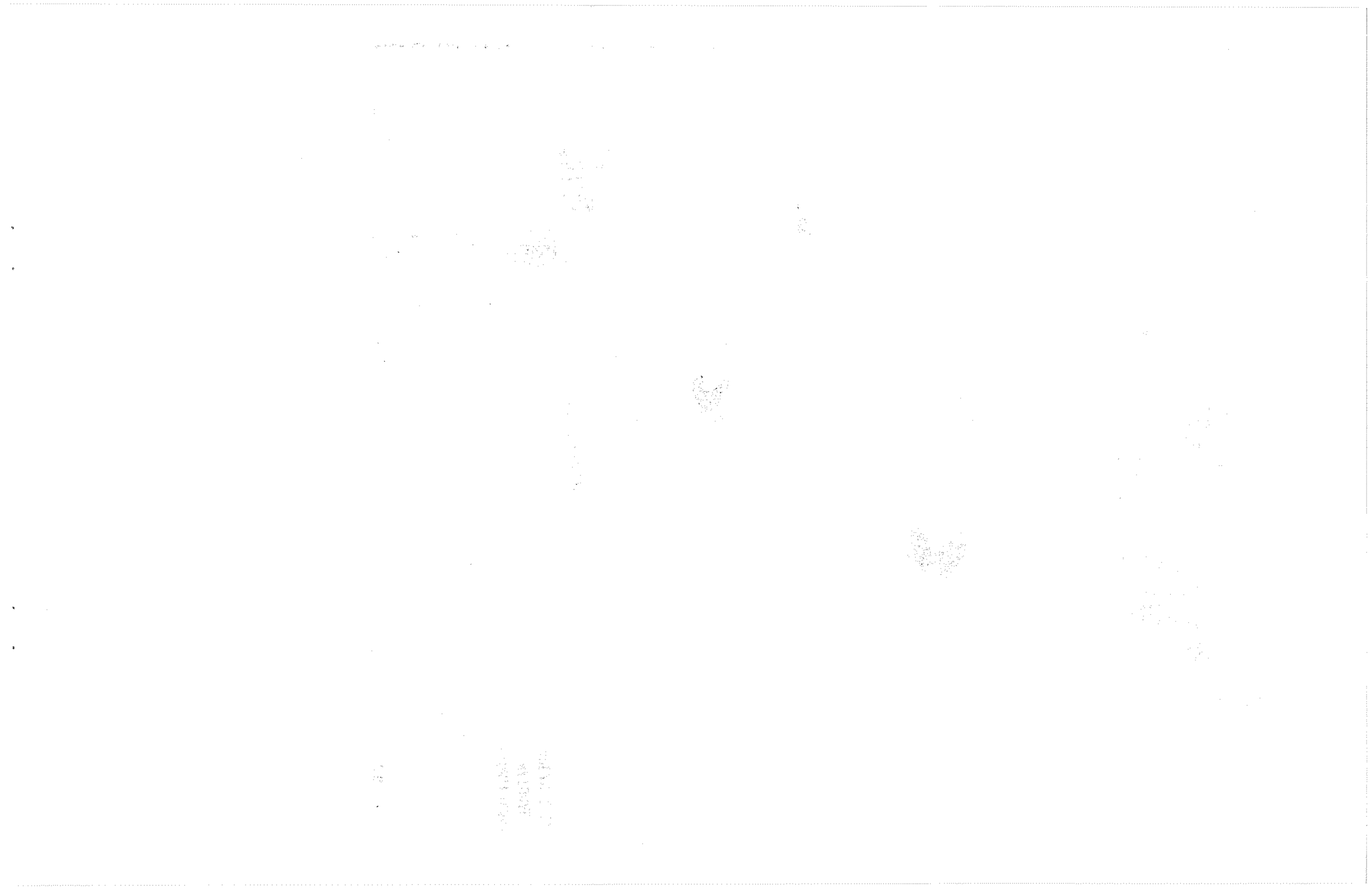
SIGNIFICANT NATURAL AREAS 1-12

PINEHURST
ABERDEEN
AND
SOUTHERN
PINES
MOORE COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - PLANNING AND RESEARCH BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALE

APRIL, 1982



1. SH6-VonCanon Longleaf Pine Forest
2. SH7-NC73 Powerline Clearing
3. SH8-Joes Fork Creek Pocosin
4. SH24-Camp Gertrude Tufts Pine Stand
5. SH9-Southern Pines Town Reservoir Park
6. SH10-Whitehall Center Pine Forest
7. SH16-Pinecrest Seeps
8. SH12-Mile-away Farm
9. SH13-Johnson's Mill Pond Bog
10. SH14-Weymouth Woods/Boyd Estate
11. SH15-Paint Hill
12. SH18-Quail Hollow Farm Resinous Boneset Site

Alternative A does not directly impact any of these known natural areas, but Alternative B impacts two areas--Joes Fork Creek Pocosin and Paint Hill. Alternative C will impact Paint Hill.

Within these natural areas resides the animal life associated with them. The only federally listed endangered species within the planning area is the red-cockaded woodpecker. The location of colonies have been mapped and marked. Every effort should be made to avoid these areas.

B. SOCIAL ENVIRONMENT

1. HOUSING AND COMMUNITY COHESION

The development in this area has been very community oriented. Many single-family and multi-family developments are clustered around golf courses. Some are walled-in with only one or two entrances. Some of the older residential areas are grouped in blocks by street grid systems. Alternate A logically affects the lowest number of houses at 13, whereas alternate B affects the most at 68. Alternate C affects 29 houses.

2. NOISE POLLUTION

In general the noise levels along certain streets can be expected to rise in the future because of increased usage. Adverse noise conditions are more prevalent in areas of high traffic congestion and on facilities that are functionally misused such as residential streets used by cross town traffic.

Higher noise levels due to highway construction are taken into consideration by engineers. Noise prediction analyses are made during the planning stage of a highway project. By comparing these predicted levels with current noise standards the engineers can forecast possible areas of excessive noise pollution and take steps to reduce them. Some noise sensitive areas include schools, churches, hospitals and secluded neighborhoods. Major truck traffic should be kept on major cross town and bypass facilities, and grades should be kept to a minimum to help keep noise levels low.

Of the three alternatives Alternative C would provide the best combination of widening and new construction to reduce noise levels around noise sensitive areas in the planning area. It has

fewer miles of new construction and yet retains bypasses around Pinehurst and Aberdeen through currently undeveloped areas.

3. SCHOOLS AND CHURCHES

A thoroughfare system should allow for good access to and from an area's schools and the safe movement of busses.

4. RECREATION AND PARK FACILITIES

There are several public parks in the planning area, the two largest being at Aberdeen Lake and the Southern Pines reservoir.

5. NATURAL AND HISTORIC LANDMARKS

The Sandhills area of Moore County was settled by Europeans in the mid-1700's and efforts have been made to preserve and protect that heritage through the area's buildings. There are several buildings of note on the National Register and its Study List. Figure V-2 shows their approximate locations.

1. Aberdeen Historic District--NR
2. Belvedere Hotel--SL
3. Bethesda Presbyterian Church--NR
4. Site of K. Black House
5. Malcolm Blue House and Farm--NR
6. James Boyd House(Weymouth)--NR
7. Site of J. Buchan House
8. Civic Club Building--SL
9. Seaboard Coast Line Depot
10. Jefferson Inn--SL
11. Knollwood
12. Lloyd-Howe House--NR
13. Site of William McDeed House
14. Site of Arch. McMillan Houses
15. Mid Pines Inn
16. William Millard House
17. Niagara
18. Paint Hill Farm
19. Pine Needes Inn(St. Joseph's Hospital)
20. Pineholme
21. Pinehurst Depot
22. Pinehurst Historic District--NR
23. Ray House
24. Ray's Mill
25. Shaw House
26. Duncan Shaw House
27. Stoneybrook
28. Tremont Farm
29. Royalton Pines Dairy
30. Von Herff House--SL

Construction or improvement of a facility may adversely affect a nearby historic building, landmark, or district in different ways depending on, among other things, the proximity of the facility to the site and the intended use of the facility and the site.

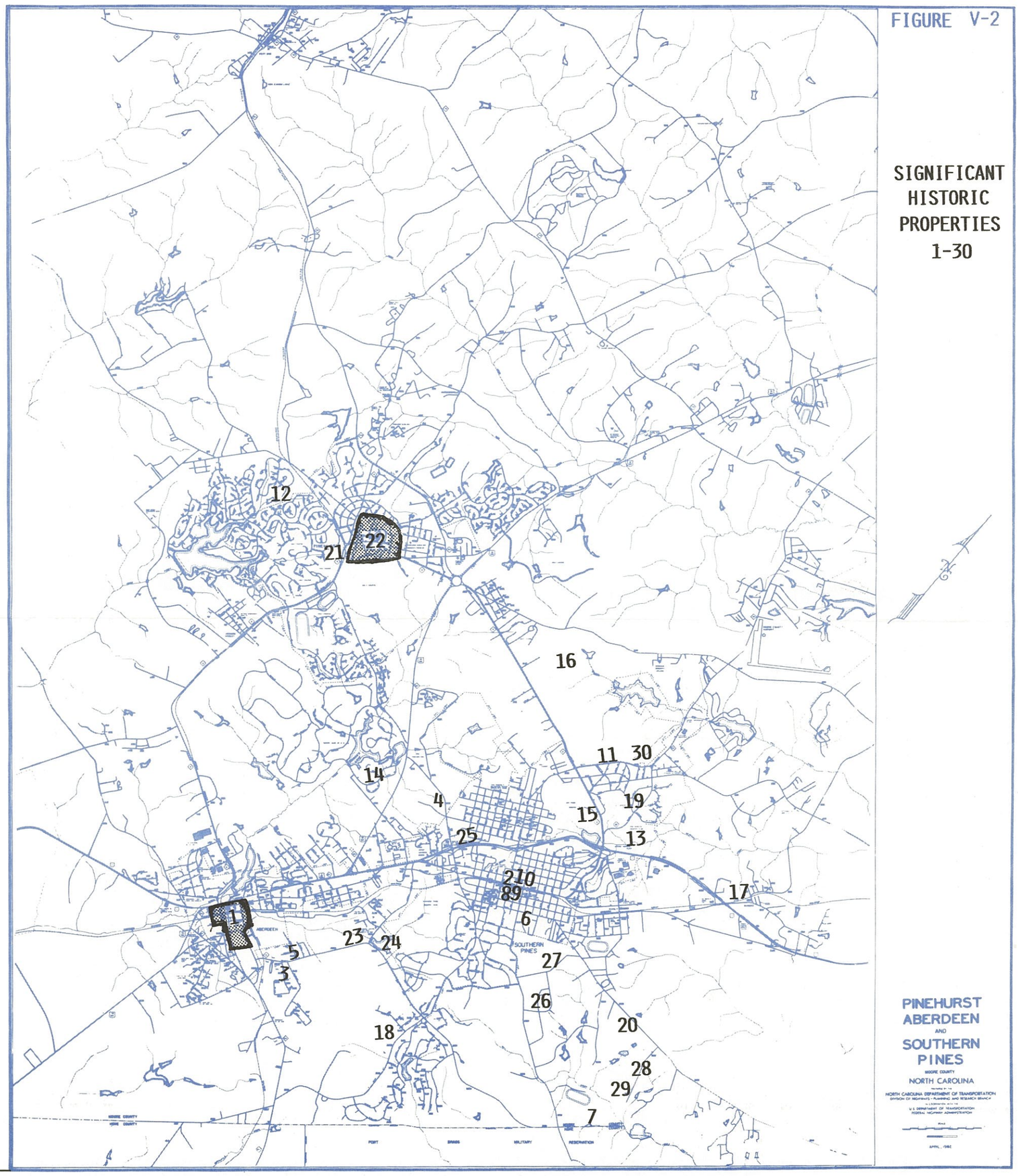


FIGURE V-2
SIGNIFICANT HISTORIC PROPERTIES 1-30
12
21
22
16
11
30
14
4
19
15
25
13
210
89
17
1
6
23
24
5
3
27
26
18
20
28
29
7
ABERDEEN
SOUTHERN PINES
MOORE COUNTY
YORK COUNTY
PINEHURST ABERDEEN AND SOUTHERN PINES
MOORE COUNTY
NORTH CAROLINA
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
APRIL, 1982

Alternative A would affect:

4. K. Black House
21. Pinehurst Depot
22. Pinehurst Historic District
25. Shaw House

Alternative B would affect:

4. K. Black House
14. Arch. McMillan Houses
15. Mid Pines Inn
18. Paint Hill Farm
19. Pine Needles Inn
22. Pinehurst Historic District
23. Ray House
25. Shaw House
27. Stoneybrook

Alternative C would have an effect on:

4. K. Black House
18. Paint Hill Farm
19. Pine Needles Inn
23. Ray House
24. Ray's Mill
25. Shaw House

6. AESTHETICS

Primary among the senses used by the driver to detect and correct his relationship with the environment is the sense of vision. For this reason, roadway designs and operations should be planned to minimize confusion and encourage alertness of the driver. Shrubs and trees provide pleasant surroundings, however, each has accident potential when planted too close to curbing and signs. Through proper design of new facilities, it is possible to strike a balance between scenic beauty and traffic safety so that neither suffers at the expense of the other.

In recent years billboard and junkyard permits have been required as a means of acquiring and maintaining certain visual standards along US, NC, and Interstate-type roads. Future efforts should strive to maintain these standards. Construction of new facilities presents the opportunity to improve the visual aspects of the urban environment through design.

7. PUBLIC HEALTH AND SAFETY

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

Although Alternate A will reduce congestion by increasing the capacity of the road system it will not improve mobility or access to the surrounding area. The differences in Alternatives B and C are not significant. Although Alternative B has more miles of new

facilities, there are more miles of widening in Alternate C.

8. NATIONAL DEFENSE

In accordance with Federal guidelines, PPM 50-6-1, the North Carolina Department of Transportation has designated US 1 as part of the National Defense Highway system.

9. ARCHAEOLOGICAL CONSIDERATIONS

Five archaeological sites have been indentified inside the planning area due to previous development and future improvements there should have minimal impact on them. If any sites of archaeological importance are found during new construction effort should be made to reduce any impact on them.

10. HAZARDOUS MATERIALS

Along with the popularity of the area came industry. There are several places that are now classified by the EPA as containing potentially hazardous materials.* There approxamate locations are shown in Figure V-3.

1. Aberdeen Pesticide Dumps
2. Carolina Galvanizing Corp
3. Farm Chemical
4. Geigy Chemical Corp
5. How Enterprises
6. Moore County Landfill
7. W C Richards Co Inc
8. SCM Proctor Silex/Wearever

*Dept. of Environment, Health, and Natural Resources, NC Solid Waste Management Section

General high risk hazardous waste industries include tobacco manufacturing, textiles, lumber, furniture, paper, printing, chemical and petroleum refining. Potentially hazardous material sites in an area should be identified early in the planning process.

C. ECONOMIC ENVIRONMENT

1. BUSINESS AND DEVELOPMENT IMPACTS

The effidiency of the transportation system can have a significant impact on the economic development nd well-being of an area, affecting both workers and the business community. Transportation costs are often the critical variables in the economic decision process and may determine the sites of manufacturing concerns, the cost of goods delivered to an area, and the relative competitiveness of area industries. Alternative plans can be examined in terms of their impacts on (1) business, (2) employment and income, (3) land development patterns, and public utilities.

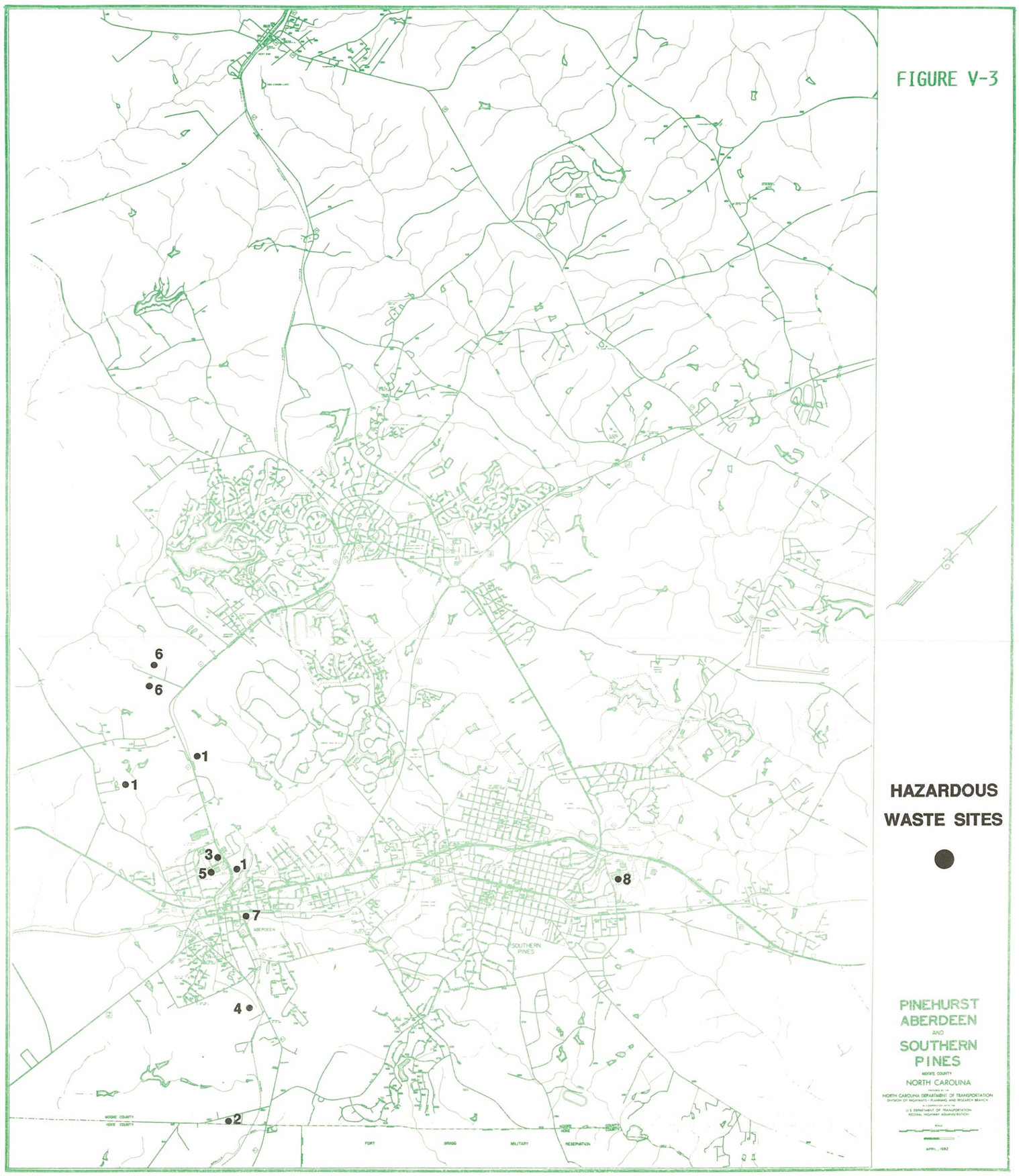


FIGURE V-3
HAZARDOUS WASTE SITES
PINEHURST ABERDEEN AND SOUTHERN PINES
MOORE COUNTY
NORTH CAROLINA
APRIL, 1982
6
6
1
1
3
5
1
7
4
2
8
PINEHURST
ABERDEEN
SOUTHERN PINES
MOORE COUNTY
HOKE COUNTY
FORT BRAGG MILITARY RESERVATION

2. TRAVEL SERVICE

Private and charter air service to the area is available at the Moore County airport. There is Trailways bus service to Aberdeen, and Amtrack rail passenger service from the Southern Pines depot.

TABLE V-2
ENVIRONMENTAL EFFECTS OF ALTERNATE PLANS

	A	B	C
Total Road Miles	128.3	154.3	137.5
Major Thoroughfares	78.6	95.6	91.0
Minor Thoroughfares	49.7	58.7	46.5
Miles of Construction	24.1	34.4	35.1
Widening	24.1	4.9	23.8
New Location	0.0	29.5	11.3
Schools Affected	3	3	3
Churches Affected	3	7	6
Hospitals Affected	1	1	1
Dwelling Units Affected	13	68	29
Businesses Affected	13	25	16
Parks Affected	0	1	0
Streams Crossed	21	44	24
Vehicle Miles of Travel	1109818	1098233	1094743
Average Speed of Travel	40.9	41.3	41.6

VI. RECOMMENDATIONS

A. RECOMMENDED THOROUGHFARE PLAN

This plan was designed to alleviate both existing and projected traffic movement problems in the Sandhills area. The 1989 Thoroughfare Plan is shown in Figure VI-1. A detailed street index is in Appendix C.

As described in Section II a road system is comprised of thoroughfares with different sizes and functions. The roads on the recommended thoroughfare plan are as follows:

MAJOR THOROUGHFARES

Airport Rd(SR 1843)

This road brings traffic into the area from Whispering Pines. The intersection with NC 22 is very busy during rushhour and a high potential for accidents. In the future a signal at this intersection may be warrented, but because of airport restrictions the intersection may have to be realigned to accommodate the traffic light equipment. This road also has traffic on it generated by Sandhills Community College and other educational institutions. Presently from the Circle to NC 22 this road is only 22 feet wide. This reduces the capacity of the road. It is recommended that from the new Knoll Road intersection to NC 22 the road be widened to a full 24-foot cross section.

Ashe St

A street in the Southern Pines central business district (CBD) parallel to Broad Street.

E and W Broad St(SR 2116, SR 2080, SR 2053)

This one-way pair makes up most of the Southern Pines CBD. West Broad brings in traffic from both sides of town and East Broad, from New York Ave. to Vermont Ave., helps direct it around the railroad tracks. There is alot of parking traffic on these roads and potential for accidents, but the speed limit is low enough.

Connecticutt Ave(SR 2033)

This two-lane road is the main route from Southern Pines into the Fort Bragg Military Reservation just over the county line. An entrance to the Weymouth Woods nature preserve is along this road and entrances to several of the area's horse farms.

Juniper Lake Rd(SR 1216)

This is the major east-west connection between US 15-501 and NC 211 north of Pinehurst.

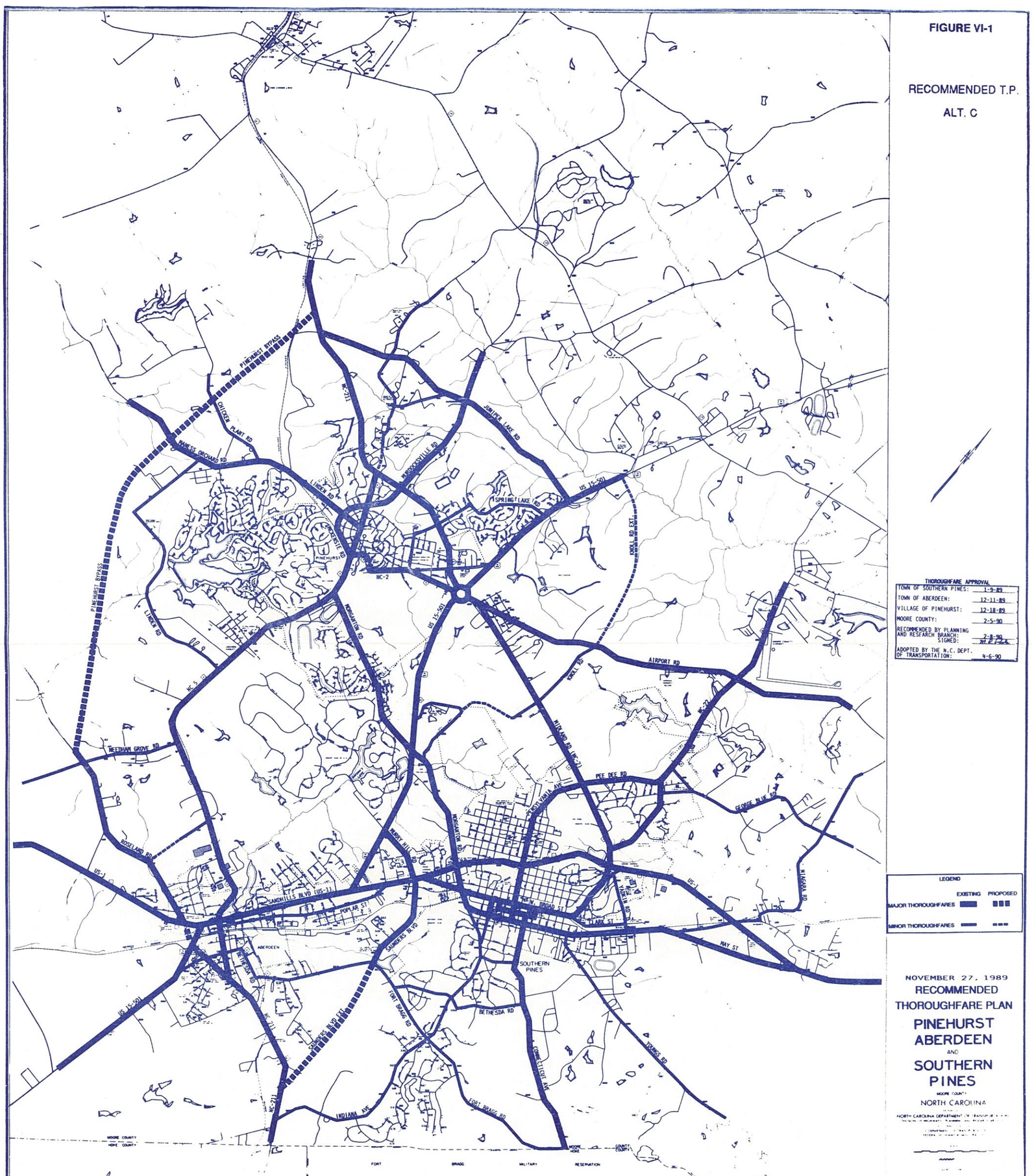


FIGURE VI-1

RECOMMENDED T.P.

ALT. C

THOROUGHFARE APPROVAL	
TOWN OF SOUTHERN PINES:	1-9-89
TOWN OF ABERDEEN:	12-11-89
VILLAGE OF PINEHURST:	12-18-89
MOORE COUNTY:	2-5-90
RECOMMENDED BY PLANNING AND RESEARCH BRANCH: SIGNED:	2-8-90
ADOPTED BY THE N.C. DEPT. OF TRANSPORTATION:	4-6-90

LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARES		
MINOR THOROUGHFARES		

NOVEMBER 27, 1989

RECOMMENDED THOROUGHFARE PLAN

PINEHURST ABERDEEN AND SOUTHERN PINES

MOORE COUNTY

NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Linden Rd North(SR 1115) and Maness Orchard Rd(SR 1122)

These two sections of road serve as the main entrance to Pinehurst from Foxfire and points west. Pinehurst's larger residential area has several entrances along Linden as does the Pinewild development.

May St(SR 2080)

May Street carries traffic around the south side of the Southern Pines CBD from Morganton Rd to US 1.

McKensie Rd(SR 1209)

McKensie Rd is the outermost loop road in the old part of Pinehurst that circles the Hotel. It channels traffic around that residential area.

Morganton Rd(SR 1309)

This is one of the few crosstown routes through the center of the area and, therefore, heavily travelled. It is recommended that the road be widened to four-lanes divided from the entrance of Country Club of North Carolina in Pinehurst to US 15-501, four lanes divided with a grass median from US 15-501 to the National Guard Armory, three lanes from the Armory to Broad Street with improvement of the interchange with US 1.

Murdocksville Rd(SR 1209)

This is a two-lane road south into Pinehurst from Murdocksville.

Murry Hill Rd(SR 1204), Saunders Blvd(SR 2053), Saunders Blvd Ext

These three sections of road are meant to form an Aberdeen bypass on the east side of town. Murray Hill would be widened to three lanes because of the numerous driveways along that stretch of road. Saunders Boulevard should also be widened to three lanes and the intersection with Sandhills Boulevard realigned with Murray Hill. That would improve the accident rate at those intersections. Saunders Boulevard should then be extended from Bethesda Road to Raeford Rd southeast of Aberdeen. This bypass would divert through traffic travelling south to NC 211 from US 1 and US 15-501 and reduce the congestion on Sandhills Boulevard in Aberdeen.

NC 2, Cherokee Rd, Azalea Rd, Palmetto Rd, Midland Rd(SR 2035)

Cherokee, Azalea, and Palmetto are the street names for NC 2 in Pinehurst. In historic Pinehurst NC 2 winds around past the Hotel, the main golf club, the Village Center, and the Golf Hall of Fame toward the Circle. These sections are narrow two-lane roads which carry a lot of traffic, but because they are part of the Pinehurst historic district only

if there were no other feasible or reasonable alternative would widening them be warrented. The Midland Road section, however, is divided with a planted median which carries traffic well. There are already several median cuts along its length, though, which reduces its efficiency and increases its accident potential. Restricted access across the median should be maintained as much as possible. SR 2035 carries the NC 2 traffic into Southern Pines to Broad Street and the CBD.

NC 5, Beulah Hill Rd, South St(SR 2064)

This route is a crosstown road that connects Pinehurst with Aberdeen. The road passes under a narrow railroad bridge making it difficult to widen NC 5 through Pinehurst. It is recommended, though, that NC 5 be widened to three lanes from Linden Road South to Sandhills Boulevard. The bridge over Aberdeen Creek will be replaced with a four-lane parallel structure and the curve at Pinehurst Street straightened a bit which should improve safety and capacity in that area. In Aberdeen NC 5 meanders through town toward the historic Bethesda Church area, but the main route for traffic through town is on South Street to Raeford Road.

NC 22, Central Dr

NC 22 begins in Greensboro, seventy-seven miles north, and ends in Southern Pines. It brings in traffic from Carthage and Whispering Pines. The Town's reservoir and St. Joseph's Hospital are also along this road. There will be more growth north of the Airport along with the several homes and larger developments already along Central Drive. It is recommended that NC 22 be widened from the Airport to Midland Road to three lanes to allow for the increase in turning movements.

NC 211, Raeford Rd

This route brings traffic south into the Sandhills from US 220 and north from Raeford. In town it joins US 1 and US 15-501 as the main artery through the area. Recommended improvements to those sections are dealt with under those headings. The state is planning to widen NC 211 from Candor to Raeford. As part of that project it is recommended that Raeford Road in Aberdeen be widened to four laned from US 15-501 to at least the county line.

Pinehurst Bypass, Roseland Rd(SR 1112)

As part of the widening of NC 211 it is recommended that a four-lane divided bypass be built around Pinehurst using part of Roseland road in Aberdeen and constructing a bridge across the railroad tracks to meet Raeford Road. The intersection of US 1, US 15-501, and NC 211 should be reconfigured to facilitate better traffic movement from one road to another. The bypass would reduce congestion and accident potential through both the Pinehurst and Aberdeen historic districts and along NC 5.

Pennsylvania Ave(SR 1848), Pee Dee Rd(SR 1848)

This street is a major north-south route through Southern Pines from the CBD through residential areas of town. Pensylvania Avenue is already three lanes along most of its length and moves traffic well.

US 1, Sandhills Blvd

Sandhills Boulevard is the section of road where US 1, US 15-501 and NC 211 follow the same route. Sandhills Boulevard from Broad Street to Roseland Road is the most congested stretch of road in the planning area. One reason is the relatively large traffic volumes. Another is the numerous driveway's along the street. The boulevard also has the highest accident rate in the area. To alleviate these problems it is recommended that the cross section of the road be modified. The center turn lane should be replaced with a 16-foot planted median. Along the outside of the two 12-foot lanes another 4-foot median should be constructed on either side of the road to separate the through traffic from a 14-foot service road onto which the driveways will have access. There would be median cuts at only the signalized intersections and other major access points such as in front of the Aberdeen Fire Station. The one-way service roads would access the mainline at certain strategic points. Appendix C contains information on the suggested typical section.

US 1 is part of the state's four-lane Intrastate System. The state already has plans to widen several stretches of US 1 from Raleigh to South Carolina. Although such a high type of facility is not warrented in the planning area by 2010 because that section is already four lanes, a US 1 bypass of Southern Pines and Aberdeen should be givin consideration in the future.

US 15-501, Poindexter St

This route carries traffic into the Sandhills from Raeford and Laurinburg. Inside the planning area it carries traffic between Pinehurst and Aberdeen. The state's project to widen US 15-501 between the traffic circle and US 1 is scheduled for completion in fiscal year 1992.

MINOR THOROUGHFARES

Aiken Rd(SR 1853), Fairway Drive(SR 1854), George Blue Rd (SR 1853), Niagara Rd(SR 1802)

These roads lie on the east side of the planning area. George Blue Road parallels US 1 from Lakeview into Southern Pines. Niagara Road brings traffic into town from Whispering Pines. The land use along them is mainly rural residential.

Chicken Plant Rd(SR 1121)

This road presently has a relatively low volume of traffic. When the Pinehurst bypass is built, though, the amount may

increase somewhat. At that time it will most likely be paved.

Clark St(SR 2032), Yadkin Rd(SR 2029)

These two streets separate a residential area from a more industrial area. Clark Street carries traffic to and from the CBD and Yadkin Road, with access to US 1 and May Street, carries traffic to the manufacturing plants on the east side of town.

Fort Bragg Rd(SR 2074)

This road connects Aberdeen with the south side of Southern Pines, Connecticut Road and Fort Bragg. An entrance to the Weymouth Woods Nature Preserve is along this road as is an historic house and mill.

Glasgow St(SR 2066), Bethesda Rd(NC 5)

These are two well-travelled streets in residential Aberdeen. Glasgow Street allows access to Poindexter Street and Raeford Road and Bethesda connects historic Aberdeen with historic Bethesda Church and the Malcolm Blue property.

Green Ave(SR 1110), Needham Grove Rd(SR 1103)

These two roads will connect the NC 211 Pinehurst bypass with NC 5. Green Avenue should be extended to connect with Roseland Road. This will give better access to the industrial area along NC 5 and reduce the congestion at Sandhills Boulevard.

Bethesda Rd(SR 2042), Highland Rd

These two form crosstown links through the residential area on the south side of Southern Pines. Highland Road is a local street. Bethesda Road is a state secondary road. Part of Bethesda Road is unpaved. Under the Highway Trust Fund the road is scheduled to be paved.

Kelly Rd, Rattlesnake Trail, Gun Club Rd, Spring Lake Dr

These four are local streets through the newer section of Pinehurst. They allow access to US 15-501, NC 211, and NC 2 from a residential section of the village.

Indiana Ave(SR 2036, 2025)

This road connects the Southern Pines CBD with NC 211 south of Aberdeen. When the Saunders Boulevard Extension is built the traffic through the residential area will be reduced somewhat.

Knoll Rd(SR 1912), Knoll Rd Ext

The present link between Airport Road and Midland Road and the connectors on either end will form a bypass around the

traffic circle. This will be a valuable facility because there are very few lateral connections between Southern Pines and Pinehurst. Both new sections should be two-lanes with the possibility of widening them to three in the future as more development occurs.

Linden Rd South (SR 1115)

This road carries traffic around one of the larger residential areas of Pinehurst. Its unusual alignment and residential nature call for low travel speeds along most of the road.

Ohio Ave(SR 2117), Youngs Rd(SR 2026)

This radial brings traffic in from the far east section of the county. Many of the horse farms in the area have entrances along this road.

Page Rd(SR 1208)

The Moore County Hospital is located on this road. Many associated medical offices are also here.

Pinecrest School Rd(SR 1901, 1905)

The school is located at one end of this loop road. The regional shopping mall is located at the other. Knoll Road will connect up at about the middle of the loop giving better access to both attractors.

Poplar St(SR 2055)

This street parallels Sandhills Boulevard. For most of its length it is residential with commercial areas at both ends with higher traffic levels.

Richmond St(SR 1214), Taylortown Rd(SR 1210)

These are two of the few paved streets in Taylortown. Because of the tight curve and hilly terrain on Taylortown Road it is recommended that the road be realigned to meet NC 5 at NC 211. This would give better access in and out of Taylortown.

B. CONSTRUCTION PRIORITIES

One of the most important results of a thoroughfare plan study is a priority list of projects which when implemented will carry out the objectives of the thoroughfare plan. These goals can be expressed both subjectively, as in Section E of Chapter III, or objectively using numerical standards.

A method commonly used to express both sides of the issue is the use of a benefit/cost ratio to prioritize the projects. User benefits include cost savings resulting from an improvement through reduction in:

1. initial construction costs
2. right-of-way costs
3. road maintenance costs
4. accident costs
5. fuel costs
6. auto cost, depreciation, and maintenance
7. driving time

Dollar cost estimates for construction and right-of-way for each recommended project are listed in Table VI-1. The priorities recommended in Table VI-1 are not intended as an order for action, but merely suggest a priority based on the results of the study. Each priority level includes several projects to allow for some flexibility in the light of future cost estimates. Construction and right-of-way costs are in 1989 dollars and are based on preliminary estimates made by the project engineer.

C. TRAFFIC OPERATIONS

Traffic operations deal with getting the most effective use possible out of both an existing or improved street system by making specific changes in the movement of traffic at specific locations on the network. Examples include one-way streets, coordination of traffic control devices, separate turn lane provisions at intersections, channelization of intersection approaches, and removal of on-street parking near intersections. These and other traffic control measures can substantially increase the capacity and efficiency of a street or street system.

Intersection capacity is the limiting factor in the capacity of adjoining facilities. Due to conflicting traffic movements, intersections are also the sites where most accidents occur. Conflicting traffic movements at intersections are controlled by traffic control devices. The type of traffic control device used at a particular intersection is dependent on traffic and safety warrants at that intersection and may vary from a simple stop sign at minor intersections to an intricate signal system at a major intersection.

Much of the effectiveness of the Southern Pines-Aberdeen-Pinehurst Thoroughfare Plan will rely on the operating efficiency of the major intersections and the signalization system associated with them. Poor timing and coordination of signals can be a major contributor to congestion on an otherwise adequate system.

TABLE VI-1
CONSTRUCTION PRIORITIES, BENEFITS AND IMPACTS

PROJECT DESCRIPTION		CONST&R/W COST (x$1,000)	USER BENEFITS (x$1,000)	B/C RATIO	IMPACT PROBABILITY Economic	IMPACT PROBABILITY Environ	POSSIBLE FUNDING SOURCE
FIRST PRIORITY							
NC 211 Pinehurst Bypass	C	13,868	571,210	30.4	.90	+.80	R-2591
	R	4,895					
Green Ave Connector	C	800	156,737	164.5	.80	+.80	
	R	153					
NC 211 Widening	C	7,572	37,319	4.1	.65	+.50	R-2592
	R	1,460					
Morganton Rd Widening	C	6,290	12,533	27.1	.40	+.40	U-2420
	R	463					
SECOND PRIORITY							
Knoll Rd	C	1,188	229,092	116.1	.30	+.50	Develop
	R	785					
US 1 Widening	C	4,605	90,233	19.6	.75	+.70	State
	R	0					
Knoll Rd Ext	C	2,376	73,577	15.6	.40	+.60	Develop
	R	2,356					
Aberdeen Bypass							State
Murray Hill Widening	C	600	42	0.1	.30	+.40	
	R	0					
Saunders Blvd Widening	C	1,037	8,314	7.4	.40	+.20	
	R	89					
Saunders Blvd Ext	C	2,457	33,550	12.9	.45	+.10	
	R	138					
NC 5 Widening	C	2,776	35,892	11.4	.50	+.50	State
	R	380					
NC 22 Widening	C	2,680	26,315	8.5	.55	+.45	State
	R	406					
Airport Rd Widening	C	1,448	2,137	1.3	.60	+.50	State
	R	154					
Yadkin Rd Widening	C	576	1,413	2.3	.50	+.30	State
	R	52					

Some traffic operation improvement guidelines that may be appropriate throughout the network include:

1. All intersections should have some type of control.
2. Four-way stop signs should not be utilized at any intersection.
3. Stop and yield signs should be used on local streets in such a manner so as to discourage through traffic.
4. Major intersections should have traffic control devices consistent woth actual traffic demands according to accepted signalization warrents. Unwarrented use of traffic signals can increase delay and increase traffic accidents.
5. Signals at major street intersenctions should be phased to allow maximum movement through the intersection. The recommended munimum cycle length is 60 seconds.
6. Signals along major traffic corridors should be interconnected to facilitate maximum progression at reasonable speeds along said corridors.
7. Use of special cycle phases (i.e. exclusive pedestrian movements, left turns, etc.) should be minimized.
8. Parking should be prohibited for 30 feet in advance of each intersection and for 20 feet in advance of each crosswalk.
9. Stop signs should be placed at all minor street intersections with major streets where signals are not warrented.
10. All traffic control devices should be installed and standardized in accordance with the Manual on Uniform Traffic Control Devices.

Manual on Uniform Traffic Control Devices (Washington, D.C., U.S. Dept of Transportation, 1988).

VII. IMPLEMENTATION

A major part of implementing a thoroughfare plan lies in the initiative of the municipalities for whom the plan was formulated. There are several tools available to municipalities for the implementation of their thoroughfare plan.

A. 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 the 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.

The General Statutes also require that, as part of the plan, the governing body of the municipality and the Department of Transportation shall reach an agreement on the responsibility for both existing and proposed streets and highways included in the plan. The General Statutes stipulate that the Department of Transportation shall be responsible for those facilities which serve major volumes of through traffic and traffic from outside the planning area to major business, industrial, governmental, and institutional destinations located inside the municipality. The municipality is responsible for those facilities which serve primarily internal travel. Facilities which are designated as State responsibility shall be constructed and maintained by the Division of Highways. Facilities designated as municipal responsibility shall be constructed and maintained by the municipality.

Mutual adoption of the Thoroughfare Plan lets officials use other planning tools available to them for implementation of the plan. These include: Town funding, Federal revenue sharing or block grants, urban bonds, redevelopment, zoning ordinances, advance purchase of rights-of-way, subdivision ordinances, future street line ordinances, official street maps, and lobbying for state construction.

B. TRANSPORTATION IMPROVEMENT PROGRAM

Every year, in the spring, the North Carolina Department of Transportation holds public hearings in each of its fourteen divisions to gather local input for compilation of the list of highway, rail, aviation, bicycle program, public safety and public transit projects on which the state will spend money during the next fiscal year. That is the time for a municipality to lobby for any project on their thoroughfare plan or of state responsibility to be included in the state TIP.

C. HIGHWAY TRUST FUND

In 1989 the General Assembly passed a law establishing the Highway Trust Fund. Some goals which the Trust Fund is meant to accomplish are: to complete the designated four-lane Intrastate System, construct multi-lane urban loop and connector roads around designated cities, supplement the secondary roads appropriation to pave all the unpaved state-maintained secondary roads, and

supplement the Powell Bill program.

D. POWELL BILL AND HOUSE BILL 1211

Chapter 136, Article 41, Section 3 of the General Statutes, or the Powell Bill, directs that "the funds allocated to the cities and towns...shall be expended...for the purpose of maintaining, repairing, constructing, reconstructing or widening of any street or public thoroughfare including bridges, drainage, curb and gutter, and other necessary appurtenances within the corporate limits...or for meeting the municipalitiy's proportionate share of assessments levied for such purposes, or for the planning, construction and maintenance of bikeways located within the rights-of-way of public streets and highways."

This includes the acquisition of right-of-way. House Bill 1211 set maximum percentage rates for participation by the municipalities in the purchase or acquisition of right-of-way for a project. The exact amount is dependant upon the municipality's willingness to pay, its ability to pay, and its willingness to acquire right-of-way on its own in anticipation of the project being completed.

The cost of purchasing the right-of-way for a project is usually the highest percentage of the total cost of a project and quite often the hardest to plan for. In some instances the high cost of right-of-way for a project could eliminate it completely from consideration. That is why protection or donation of rights-of-way is an excellent way to conserve the money available for highway construction. There are several methods municipalities can use to acquire rights-of-way for projects on their thoroughfare plan.

E. LOCAL SUBDIVISION CONTROLS

A subdivision ordinance requires that every subdivider submit a plot of his proposed subdivision to the local Planning Commission. Certain standards set by the Commission must be met by the developer before a building permit can be issued for construction of the development. By using this process it is possible to reserve or protect the necessary right-of-way needed for future street construction in accordance with the adopted Thoroughfare Plan.

F. LOCAL ZONING REGULATIONS

Like subdivision ordinances zoning can be used to planning future traffic patterns because they provide a degree of stability to the development on which those patterns are based. Good zoning also establishes a standard for development which will aid traffic operations on major thoroughfares and help minimize the strip commercial development along major thoroughfares which causes traffic friction and reduces traffic safety.

G. DEVELOPMENT REVIEWS

Permit requests for driveway access to a state-maintained street or highway are reviewed by the District Engineer's office

and the Traffic Engineering Branch of the Department of Transportation. Any development expected to generate large volumes of traffic (e.g. shopping centers, fast food restaurants, large industries, etc.) may be comprehensively studied. If this is done early in the process it is often possible to significantly improve the development's accessibility at minimal expense. Since the municipality is often the first point of contact for developers it is important that the municipality advise them of this review requirement and cooperate in the review.

H. OFFICIAL STREET MAP

A municipality may, through special enabling legislation, adopt an official street map which indicates existing or future street lines. No new construction or reconstruction of structures would be permitted within the designated 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. Future street lines should be established to provide for the ultimate right-of-way specified in Appendix C. It must be understood that the proposed corridors are not final in regard to spending of Federal-aid funds until an Environmental Assessment or Environmental Impact Statement has been completed, thus there is some risk in reserving the corridor. This risk, however, is minimal compared to the savings in both costs and disruption to the community by planning for the facilities up front.

I. FUTURE STREET LINE ORDINANCES

Similar to the Official Street Map legislation this ordinance can be used mainly where widening of an existing street may be necessary sometime in the future. A municipality, with legislative approval, may amend its charter to be empowered to adopt any future street line ordinances. Through a metes-and-bounds description of a street's future right-of-way requirements the Town may prohibit new construction or reconstruction of structures within the future right-of-way. This approach requires specific design of the facility and would usually require surveys and public hearings to let affected property owners know what to expect and to make necessary adjustments without undo hardship. a specific ordinance can be enacted for selected streets. Whereas an Official Street Map is only good until an official federal environmental study is completed a future street line ordinance is good for an indeterminate period of time.

For those thoroughfares which a municipality intends to construct on its own here are some ways it can do so:

J. CAPITAL IMPROVEMENT PROGRAM

Another tool which makes it easier to construct a planned thoroughfare system is a municipal capital improvement program. This is a long range plan for spending money on municipal street construction or improvements, acquisition or cost sharing of rights-of-way, or any other capital improvements within the bounds of projected municipal revenues.

K. REDEVELOPMENT

This term describes efforts toward the removal or rehabilitation of deteriorated, abandoned or otherwide undesirable development. It is one of the few tools available to correct basic mistakes in the street system such as poor design and layout of a street or just too many streets built in one area.

L. MUNICIPAL SERVICE DISTRICTS

Under Chapter 160A, Sections 535-543 of the General Statutes, the legislative body of a municipality may create one of more municipal service districts in a downtown commercial area in order to raise additional funds for physical improvements. One of the stipulated purposes of the district is to facilitate traffic flow and parking. The district may float a bond issue which would be paid off with revenues from an extra ad valorem tax on all property within the district's boundaries. Once the improvements have been completed and the bonds retired, the extra tax would cease and the district would dissolve.

M. DETAILING OF THE PLAN

For the proper administration of subdivision regulations and to obtain more accurate cost estimates of proposed facilities, it would be desirable that the plan be detatiled to the extent that preliminary designs of proposed facilities are delineated on topographic mapping of a horozontal 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. This detailing of the plan could be accomplished by a consultant employed by the Town.

APPENDIX A -- TRAVEL MODEL AND ESTIMATES

Three different surveys are conducted to collect data for a typical thoroughfare plan study. These surveys provide data about existing housing, employment, and traffic in each traffic zone in the planning area. Figure A-1 shows where each of the 115 traffic zones are located.

A. DWELLING UNIT SURVEY

The 1987 housing survey results are shown in Table A-1. Each dwelling unit in the traffic zones was classified according to resident income level--Excellent(EXC), Above Average(AAV), Average (AVG), Below Average(BAV), Poor(LOW), and Special(SPE). The data was collected by field inspection. The number of dwelling units of each type in each zone were multiplied by the estimated number of persons per dwelling unit for each classification type. The estimated population by dwelling type is also listed in Table A-1.

B. EMPLOYMENT SURVEY

The results of the 1987 employment survey are shown in Table A-2. All the businesses in the planning area were categorized according to their Standard Identification Code, which is set by the Federal government. Information on employment, commercial trucks, and commercial autos was collected for each business in the traffic zones.

C. TRAFFIC COUNTS

Traffic counts were taken on various streets throughout the planning area. A count was taken at each station, where a road crosses the planning boundary, and a selection of streets inside the area. These counts were then used to calibrate the network model to correspond to the existing traffic conditions in the area.

D. GENERAL MODELING PROCEDURES

Since no home interviews or Origin-Destination survey were conducted a synthetic method was used to estimate 1987 internal trip patterns. The method consists of the following general steps:

1. Determination of zone trip productions using trip generation rates from previous studies conducted in similar areas and adjusted for a specific study.

2. Determination of trip attraction factors using multiple regression procedures.

3. Distribution of resulting trips using a five-purpose gravity model with trip length frequency curves previously developed.

4. Traffic assignments and accuracy checks so the network model corresponds to existing ground counts.

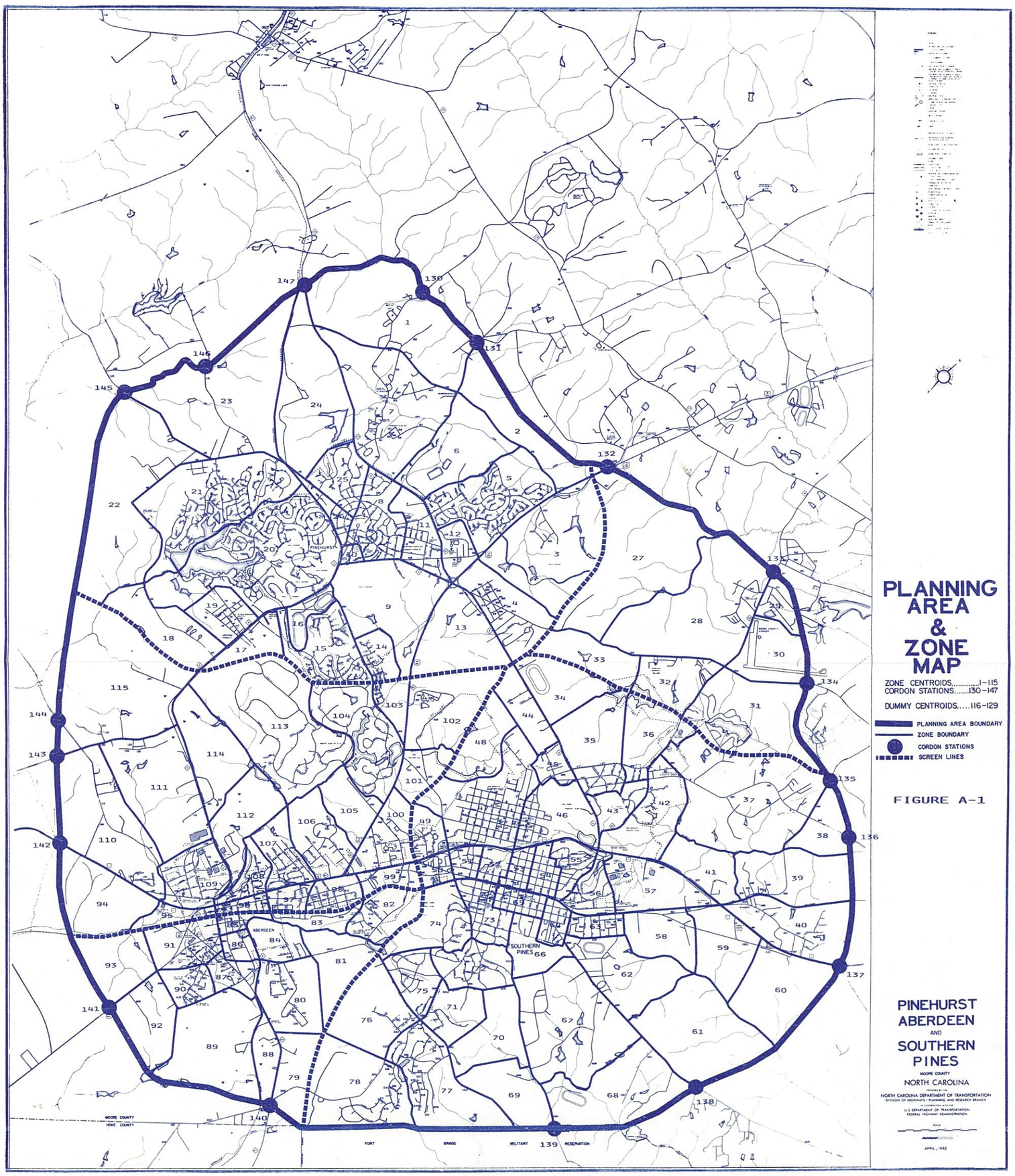

PLANNING AREA & ZONE MAP
ZONE CENTROIDS.....1-115
CORDON STATIONS.....130-147
DUMMY CENTROIDS.....116-129
PLANNING AREA BOUNDARY
ZONE BOUNDARY
CORDON STATIONS
SCREEN LINES
FIGURE A-1
PINEHURST
ABERDEEN
AND
SOUTHERN
PINES
MOORE COUNTY
NORTH CAROLINA
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - PLANNING AND RESEARCH BRANCH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
APRIL, 1982
PINEHURST
ABERDEEN
SOUTHERN PINES
MOORE COUNTY
HOKE COUNTY
FORT BRAGG MILITARY RESERVATION

TABLE A-1
INTERNAL DATA SUMMARY 1987

ZONE NO.	DWELLING UNITS EXC	AAV	AVG	BAV	LOW	SPE	COMMERCIAL TRK	AUT	UNADJ WORK ATTRS	UNADJ OTHER ATTRS
1			2	62	4		1		1	98
2		1	7	7				2	4	51
3		31	16	5	21		2	1	16	128
4			207				1	1	22	281
5		83	26	5						145
6			15	10						50
7			42	97			14		83	425
8	20	80	80				53	34	862	2126
9	13	4					17	6	86	187
10							5	3	90	176
11	1	42	20	6			9		58	211
12							4	2	1102	1947
13		41					12	3	162	364
14		3	118							152
15	4	125	34				6	3	20	231
16							7	2	13	44
17			15	17	1	1	9	1	99	380
18	2	2	4	5			2	1	77	351
19			16	50	46		3	1	16	201
20	20	1063	1						30	1234
21	14	134	43				6	2	26	272
22	3	2	41							72
23	3	5	37	4	1		1	2	16	147
24			1	1						25
25	5	89								124
26	4	42								72
27	2			1	13		2	1		40
28			26	38	9		5		59	201
29			16	2						42
30							1		12	38
31		7	59							44
32		1	66	33			5	4	240	538
33		7	4							35
34		2	4				1		9	40
35	17	48	23				2		10	155
36	1	16	11	1			4	5	45	144
37	4	2	78	36			5		45	303
38		1	7	2						34
39	1		10	21	3				2	69
40		1	80	4			4	2	39	184
41			2	6	3					35
42	1	17	59	12	4					123
43	1	17	20		1		18	2	440	812
44	1	12	8					4	10	57
45	2	68	28	28			2	1	13	177

TABLE A-1
INTERNAL DATA SUMMARY 1987

ZONE NO.	DWELLING UNITS EXC	AAV	AVG	BAV	LOW	SPE	COMMERCIAL TRK	AUT	UNADJ WORK ATTRS	UNADJ OTHER ATTRS
46	2		40	81	6	1	7	3	152	431
47		2	94	258	98		8	6	211	875
48		83	72						1	192
49			244	31			1		43	472
50			37	19			46	9	310	950
51			16	44	5		70	13	369	1194
52		1	39	12	5	1	18	13	373	966
53			30	83	2		6		85	462
54			252	39					4	341
55		43	85	60					2	230
56		23	52	2	10		4	5	39	198
57			4				88	6	1209	1687
58	3	2	2		20		5		6	59
59			6	7					1	39
60							1		4	30
61	1		1							25
62	2	5	6	1			3	2	8	52
63			27	25	10		6		15	108
64			107	57						198
65		4	123	121			10	19	136	701
66	2	9	74	3		1	1	35	155	381
67	24	10	13	2			10	2	20	109
68	20									44
69	1	9	5	1						40
70		3	3				3		3	34
71	1	44	7							79
72	4	66	63	3						169
73	12	36	162	26	1		20	16	329	1056
74	3	24	70	1	1		2		129	348
75		48	56	3						137
76		17	23	1						67
77	2	49	121	11			8	4	8	233
78	1	77	77							78
79		4	13	1					7	55
80			64							91
81	1	2	26							54
82	2	1	19	1	10					58
83			4	35						65
84	2	11	50							90
85			20	13	4		18	5	93	190
86		3	33	16						79
87			26	14	13					80
88			6	11	5		25	2	334	462
89							12	2	28	72
90			8	9	64				5	116

TABLE A-1
INTERNAL DATA SUMMARY 1987

ZONE NO.	DWELLING UNITS EXC	AAV	AVG	BAV	LOW	SPE	COMMERCIAL TRK	AUT	UNADJ WORK ATTRS	UNADJ OTHER ATTRS
92	1	1	4				5		5	35
91			19	7	24		22	2	183	413
93			1				36	1	51	88
94		1	20	19						66
95							41	7	97	413
96		1	21	19			50	20	291	905
97		2	82	5			11	15	99	366
98		1	99				6		192	867
99			7	52			10	5	432	1773
100		1	168	51			54	11	849	3107
101									6	35
102							23	1	462	1849
103			48				7		78	237
104	101	40					3	2	60	276
105		4					15	13	175	652
106			78	2			22	3	633	2541
107	1	44	44	15						134
108			6	77	16		7		75	303
109	2	1	28	87		1	50	19	429	820
110		2	66	85	7		2		23	270
111			34	31			31	6	674	1015
112			2				9	1	23	134
113	100	20					4	3	179	440
114							16	9	70	142
115			70	22			14		15	140
TOTAL	407	2637	4203	1916	485	6	1011	343	12887	42983

TABLE A-1
POPULATION

ZONE NO.	EXC	AAV	AVG	BAV	LOW	SPE	TOTAL
1			5	149	10		164
2		2	17	17			36
3		74	38	12	50		174
4			497				497
5		199	62	12			273
6			36	24			60
7			101	233	190		524
8	48	192	192				432
9	31	10					41
10							
11	2	101	48	14			165
12							
13		98					98
14		7	283				290
15	10	300	82				392
16							
17			36	41	2	2	81
18	5	5	10	12			32
19			38	120	110		268
20	48	2551	2				2601
21	34	314	103				451
22	7	5	98				110
23	7	12	89	10	2		120
24			2	2			4
25	12	214					226
26	10	101					111
27	5			2	31		38
28			62	91	22		175
29			38	5			43
30							
31		17	142				159
32		2	158	79			239
33		17	10				27
34		5	10				15
35	41	115	55				211
36	2	38	26	2			68
37	10	5	187	86			288
38		2	17	5			24
39	2		24	50	7		83
40		2	192	10			204
41			5	14	7		26
42	2	41	142	29	10		224
43	2	41	48			2	93
44	2	29	19				50
45	5	163	67	67			302
46	5		96	194	14	2	311

TABLE A-1
POPULATION

ZONE NO.	EXC	AAV	AVG	BAV	LOW	SPE	TOTAL
47		5	226	619	235		1085
48		199	173				372
49			586	74			660
50			89	46			135
51			38	106	12		156
52		2	94	29	12	2	139
53			72	199	5		276
54			605	94			699
55		103	204	144			451
56		55	125	5	24		209
57			10				10
58	7	5	5		48		65
59			14	17			31
60							
61	2		2				4
62	5	12	14	2			33
63			65	60	24		149
64			257	137			394
65		10	295	290			595
66	5	22	178	7		2	214
67	58	24	51				118
68	48						48
69	2	22	12	2			38
70		7	7				14
71	2	106	17				125
72	10	158	151	7			326
73	29	86	389	62	2		568
74	7	58	168	2	2		237
75		115	134	7			256
76	41		55	2			98
77	5	118	290	26			439
78	2	185	185				372
79		10	31	2			43
80			154				154
81	2	5	62				69
82	5	2	46	2	24		79
83			10	84			94
84	5	26	120				151
85			48	31	10		89
86		7	79	38			124
87			62	34	31		127
88			14	26	12		52
89							
90			19	22	154		195
91			46	17	58		121
92	2	2	10				14

TABLE A-1
POPULATION

ZONE NO.	EXC	AAV	AVG	BAV	LOW	SPE	TOTAL
93			2				2
94		2	48	46			96
95							
96		2	50	46			98
97		5	197	12			214
98		2	238				240
99			17	125			142
100		2	403	122			527
101							
102							
103			115				115
104	242	96					338
105		10					10
106			187	5			192
107	2	106	106	36			250
108			14	185	38		237
109	5	2	67	209		2	285
110		110	158	204	17		384
111			82	74			156
112			5				5
113	240	48					288
114							
115			168	53			221
TOTAL	975	6327	10086	4595	1163	12	23158

OCCUPANCY RATES

EXC	AAV	AVG	BAV	LOW	SPE
2.4	2.4	2.4	2.4	2.4	2.4

TABLE A-1
TRIPS BY UNIT

ZONE NO.	TRIPS BY DWELLING UNITS EXC	AAV	AVG	BAV	LOW	SPE	AUTO TRIPS	TRK TRIPS	COMM AUTO TRIPS	TOTAL TRIPS
1			9	174	7		190	7		197
2		7	33	20			60		13	73
3		220	75	14	36		345	13	7	365
4			973				973	7	7	987
5		589	122	14			725			725
6			71	28			99			99
7			197	272	134		603	94		697
8	192	586	376				1136	355	228	1719
9	125	28					153	114	40	307
10								34	20	54
11	10	298	94	17			419	60		479
12								27	13	40
13		291					291	80	20	391
14		21	555				576			576
15	38	888	160				1086	40	20	1146
16								47	13	60
17			71	48	2	1	122	60	7	189
18	19	14	19	14			66	13	7	86
19			75	140	78		293	20	7	320
20	192	7547	5				7744			7744
21	134	930	202				1266	40	13	1319
22	29	14	193				236			236
23	29	36	174	11	2		252	7	13	272
24			5	3			8			8
25	48	632					680			680
26	38	298					336			336
27	19			3	22		44	13	7	64
28			122	106	15		243	34		277
29			75	6			81			81
30								7		7
31		50	277				327			327
32		7	310	92			409	34	27	470
33		50	19				69			69
34		14	19				33	7		40
35	163	341	108				612	13		625
36	10	114	52	3			179	27	34	240
37	38	14	367	101			520	34		554
38		7	33	6			46			46
39	10		47	59	5		121			121
40		7	376	11			394	27	13	434
41			9	17	5		31			31
42	10	121	277	34	7		449			449
43	10	121	94			1	226	13		360
44	10	85	38				133		27	160
45	19	483	132	78			712	13	7	732

TABLE A-1
TRIPS BY UNIT

ZONE NO.	TRIPS BY DWELLING UNITS EXC	AAV	AVG	BAV	LOW	SPE	AUTO TRIPS	TRK TRIPS	COMM AUTO TRIPS	TOTAL TRIPS
46	19		188	227	10	1	445	47	20	512
47		14	442	722	167		1345	54	40	1439
48		589	338				927			927
49			1147	87			1234	7		1241
50			174	53			227	308	60	595
51			75	123	9		207	469	87	763
52		7	183	34	9	1	234	121	87	442
53			141	232	3		376	40		416
54			1184	109			1293			1293
55		305	400	168			873			873
56		163	244	6	17		430	27	34	491
57			19				19	590	40	649
58	29	14	9		34		86	34		120
59			28	20			48			48
60								7		7
61	10		5				15			15
62	19	36	28	3			86	20	13	119
63			127	70	17		214	40		254
64			503	160			663			663
65		28	578	339			945	67	127	1139
66	19	64	348	8		1	440	7	235	682
67	230	71	61	6			368	67	13	448
68	192						192			192
69	10	64	24	3			101			101
70		221	14				35	20		55
71	10	312	33				355			355
72	38	469	296	8			811			811
73	115	256	761	73	2		1207	134	107	1448
74	29	170	329	3	2		533	13		546
75		341	263	8			612			612
76		121	108	3			232			232
77	19	348	569	31			967	54	27	1048
78	10	547	362				919			919
79		28	61	3			92			92
80			301				301			301
81	10	14	122				146			146
82	19	7	89	3	17		135			135
83			19	98			117			117
84	19	78	235				332			332
85			94	36	7		137	121	34	292
86		21	155	45			221			221
87			122	39	22		183			183
88			28	31	9		68	168	13	249
89								80	13	93
90			38	25	109		172			172

TABLE A-1
TRIPS BY UNIT

ZONE NO.	TRIPS BY DWELLING UNITS EXC	AAV	AVG	BAV	LOW	SPE	AUTO TRIPS	TRK TRIPS	COMM AUTO TRIPS	TOTAL TRIPS
91			89	20	41		150	147	13	310
92	10	7	19				36	34		70
93			5				5	241	7	253
94		7	94	53			154			154
95								275	47	322
96		7	99	53			159	335	134	628
97		14	385	14			413	74	101	588
98		7	465				472	40		512
99			33	146			179	67	34	280
100		7	790	143			940	362	74	1376
101										
102								154	7	161
103			226				226	47		273
104	970	284					1254	20	13	1287
105		28					28	101	87	216
106			367	6			373	147	20	540
107	10	312	207	42			571			571
108			28	216	27		271	47		318
109	19	7	132	244		1	403	335	127	865
110		14	310	238	12		574	13		587
111			160	87			247	208	40	495
112			9				9	60	7	76
113	960	142					1102	27	20	1149
114								107	60	167
115			329	62			391	94		485
TOTAL	3909		19756		827		48588		2297	
		18719		5371		6		6778		57663

AUTO TRIPS / DU

EXC	AAV	AVG	BAV	LOW	SPE
9.6	7.1	4.7	2.8	1.7	.5

TRUCK TRIPS/TRUCK 6.7
COMM AUTO TRIPS/ COMM AUTO 6.7

TABLE A-1
TRIPS BY PURPOSE

ZONE NO.	HOME INTRL TRIPS	OTHER WORK TRIPS	NON HOME TRIPS	ADJST HOME INTRL	ADJST WORK ATTRS	ADJST OTHER ATTRS	NON-H ATTRS
1	160	37	88	35	1	59	41
2	59	14	32	13	3	30	21
3	296	68	163	65	13	76	54
4	799	184	439	176	18	168	117
5	587	135	323	129		87	61
6	80	18	44	18		30	21
7	565	130	311	124	69	254	178
8	1392	320	766	306	718	1269	889
9	249	57	137	55	72	112	78
10	44	10	24	10	75	105	74
11	388	89	213	85	48	126	88
12	32	7	18	7	918	1162	814
13	317	73	174	70	135	217	152
14	467	107	257	103		91	64
15	928	213	510	204	17	138	97
16	49	11	27	11	11	26	18
17	153	35	84	34	82	227	159
18	70	16	39	15	64	210	147
19	259	60	142	57	13	120	84
20	6273	1443	3450	1380	25	737	516
21	1068	246	587	235	22	162	114
22	191	44	105	42		43	30
23	220	51	121	48	13	88	61
24	6	1	3	1		15	10
25	551	127	303	121		74	52
26	272	63	150	60		43	30
27	52	12	29	11		24	17
28	224	52	123	49	49	120	84
29	66	15	36	15		25	18
30	6	1	3	1	10	23	16
31	265	61	146	58		26	18
32	381	88	210	84	200	321	225
33	56	13	31	12		21	15
34	32	7	18	7	7	24	17
35	506	116	278	111	8	93	65
36	194	45	107	43	37	86	60
37	449	103	247	99	37	181	127
38	37	9	20	8		20	14
39	98	23	54	22	2	41	29
40	352	81	194	77	32	110	77
41	25	6	14	6		21	15
42	364	84	200	80		73	51
43	292	67	161	64	367	485	339
44	130	30	72	29	8	34	24
45	593	136	326	130	11	106	74

TABLE A-1
TRIPS BY PURPOSE

ZONE NO.	INTRL TRIPS	HOME WORK TRIPS	OTHER HOME TRIPS	NON HOME INTRL	ADJST WORK ATTRS	ADJST OTHER ATTRS	ADJST NON-H ATTRS
46	415	95	228	91	127	257	180
47	1166	268	641	257	176	522	366
48	751	173	413	165	1	115	80
49	1005	231	553	221	36	282	197
50	482	111	265	106	258	567	397
51	618	142	340	136	307	713	499
52	358	82	197	79	311	577	404
53	337	78	185	74	71	276	193
54	1047	241	576	230	3	204	143
55	707	163	389	156	2	137	96
56	398	92	219	88	32	118	83
57	526	121	289	116	1007	1007	705
58	97	22	53	21	5	35	25
59	39	9	21	9	1	23	16
60	6	1	3	1	3	18	13
61	12	3	7	3		15	10
62	96	22	53	21	7	31	22
63	206	47	113	45	12	64	45
64	537	124	295	118		118	83
65	923	212	203	113	113	418	293
66	552	127	304	121	129	227	159
67	363	83	200	80	17	65	46
68	156	36	86	34		26	18
69	82	19	45	18		24	17
70	45	10	25	10	2	20	14
71	288	66	158	63		47	33
72	657	151	361	145		101	71
73	1173	270	645	258	274	630	441
74	442	102	243	97	107	208	145
75	496	114	273	109		82	57
76	188	43	103	41		40	28
77	849	195	467	187	7	139	97
78	744	171	409	164		47	33
79	75	17	41	17	6	33	23
80	244	56	134	54		54	38
81	118	27	65	26		32	23
82	109	25	60	24		35	24
83	95	22	52	21		39	27
84	269	62	148	59		54	38
85	237	55	130	52	77	113	79
86	179	41	98	39		47	33
87	148	34	81	33		48	33
88	202	46	111	44	278	276	193
89	75	17	41	17	23	43	30
90	139	32	76	31	4	69	48

TABLE A-1
TRIPS BY PURPOSE

ONE NO.	INTRL TRIPS	HOME WORK TRIPS	OTHER HOME TRIPS	NON HOME INTRL	ADJST WORK ATTRS	ADJST OTHER ATTRS	ADJST NON-H ATTRS
91	251	58	138	55	152	247	173
92	57	13	31	13	4	21	15
93	205	47	113	45	42	53	37
94	125	29	69	28		39	28
95	261	60	144	57	81	247	173
96	509	117	280	112	242	540	378
97	476	109	262	105	82	219	153
98	415	95	228	91	160	518	362
99	227	52	125	50	360	1058	741
100	1115	256	613	245	707	1855	1299
101					5	21	15
102	130	30	72	29	385	1104	773
103	221	51	122	49	65	141	99
104	1042	240	573	229	50	165	115
105	175	40	96	39	146	389	273
106	437	101	240	96	527	1517	1062
107	463	106	255	102		80	56
108	258	59	142	57		62	181127
109	701	161	386	154	357	490	343
110	475	109	261	105	19	161	113
111	401	92	221	88	561	606	424
112	62	14	34	14	19	80	56
113	931	214	512	205	149	263	184
114	135	31	74	30	58	85	59
115	393	90	216	86	12	84	59
TOTAL	46713	10740	25690	10278	10726	25663	17970

TRIP PERCENTAGE

INTERNAL OF TOTAL	81
HOME BASED WORK OF INTERNAL	23
OTHER HOME BASED OF INTERNAL	55
NON HOME BASED OF INTERNAL	22
NON HOME BASED EXTERNAL	7709

TABLE A-2
EMPLOYMENT BY STANDARD INDUSTRIAL CODE 1987

ZONE	INDUSTRY	RETAIL HIGHWAY	RETAIL OTHER	WAREHOUSE & SERVICE	OFFICE	DU's
1	0	0	0	1	0	68
2	0	2	0	2	0	15
3	0	0	0	16	0	73
4	0	0	0	18	2	207
5	0	0	0	0	0	114
6	0	0	0	0	0	25
7	12	11	0	60	0	218
8	10	66	44	601	1411	180
9	0	0	0	86	0	17
10	0	0	0	90	0	0
11	0	5	0	53	0	69
12	5	12	0	1070	15	0
13	23	8	3	128	0	41
14	0	0	0	0	0	121
15	0	0	0	20	0	163
16	3	0	0	10	0	0
17	5	47	0	35	12	33
18	4	61	0	12	0	13
19	0	9	0	5	2	112
20	0	0	0	30	3	1084
21	4	2	0	20	2	188
22	0	0	0	0	0	46
23	0	10	6	0	0	50
24	0	0	0	0	0	2
25	0	0	0	0	0	94
26	0	0	0	0	0	46
27	0	0	0	0	0	16
28	0	0	0	59	0	73
29	0	0	0	0	0	18
30	12	0	0	0	0	0
31	0	0	0	0	0	66
32	0	0	0	240	0	100
33	0	0	0	0	0	11
34	9	0	0	0	0	6
35	0	7	0	3	0	88
36	35	10	0	0	0	29
37	0	0	35	10	0	120
38	0	0	0	0	0	10
39	0	2	0	0	0	35
40	8	0	3	28	0	85
41	0	0	0	0	0	11
42	0	0	0	0	0	93
43	0	0	0	440	0	38
44	10	0	0	0	0	21
45	8	0	0	5	0	126

TABLE A-2
EMPLOYMENT BY STANDARD INDUSTRIAL CODE 1987

ZONE	INDUSTRY	RETAIL HIGHWAY	RETAIL OTHER	WAREHOUSE & SERVICE	OFFICE	DU's
46	3	1	0	139	9	129
47	0	0	3	199	9	446
48	0	0	0	0	1	155
49	0	0	35	2	6	275
50	57	51	73	81	48	56
51	43	92	43	80	111	65
52	52	37	54	190	40	57
53	14	43	16	0	12	115
54	0	0	0	4	0	291
55	0	0	0	0	2	188
56	10	5	0	19	5	87
57	1156	45	0	8	0	4
58	6	0	0	0	0	27
59	0	0	0	1	0	13
60	0	0	0	4	0	0
61	0	0	0	0	0	2
62	0	0	0	8	0	14
63	15	0	0	0	0	62
64	0	0	0	0	0	164
65	11	42	15	44	24	248
66	0	0	0	155	0	88
67	0	0	0	20	0	49
68	0	0	0	0	0	20
69	0	0	0	0	0	16
70	0	0	0	3	0	6
71	0	0	0	0	0	52
72	0	0	0	0	0	136
73	21	35	33	192	48	237
74	0	0	0	129	0	99
75	0	0	0	0	0	107
76	0	0	0	0	0	41
77	0	0	0	8	0	183
78	0	0	0	0	0	155
79	5	1	0	1	0	18
80	0	0	0	0	0	64
81	0	0	0	0	0	29
82	0	0	0	0	0	33
83	0	0	0	0	0	39
84	0	0	0	0	0	63
85	85	1	2	5	0	37
86	0	0	0	0	0	52
87	0	0	0	0	0	53
88	332	0	0	2	0	22
89	24	4	0	0	0	0
90	5	0	0	0	0	81

TABLE A-2
EMPLOYMENT BY STANDARD INDUSTRIAL CODE 1987

ZONE	INDUSTRY	RETAIL HIGHWAY	RETAIL OTHER	WAREHOUSE & SERVICE	OFFICE	DU's
91	105	24	0	54	0	50
92	5	0	0	0	0	6
93	50	0	0	1	0	1
94	0	0	0	0	0	40
95	9	68	8	7	5	0
96	68	86	15	48	74	41
97	0	0	10	36	53	89
98	0	40	132	17	3	100
99	0	203	147	65	17	59
100	79	301	231	213	25	220
101	3	0	0	0	3	0
102	0	328	20	114	0	0
103	0	0	0	50	28	48
104	0	0	0	60	6	141
105	8	77	40	40	10	4
106	6	350	115	119	43	80
107	0	0	0	0	0	104
108	0	11	6	58	0	99
109	363	34	0	27	5	118
110	4	8	6	4	1	160
111	636	15	0	2	21	65
112	0	23	0	0	0	2
113	120	13	0	46	0	120
114	0	0	0	70	0	0
115	15	0	0	0	0	92

E. 1987 INTERNAL TRIP PRODUCTIONS

Trip productions were estimated on a zonal basis in three categories: (1) trips produced by dwelling units, (2) trips produced by commercially owned passenger cars, and (3) trips produced by commercial trucks. Dwelling unit and commercial vehicle trip generation rates were adjusted from previous studies to account for the expanded planning area.

The trips produced were summed to produce total internally generated trips. Included in this total were trips that had origins on destinations outside the planning area. These external-internal trips were distributed to the zones as external trips. They were removed from the internal trips and the remaining trips were used to synthesize internal travel.

During calibration several zone productions were adjusted. Zones 80, 82, 84, 85, 86, 87, 90, 91, 92, 93, 95, 96, 97 and 98 were factored by 1.20. All zones internal trips were factored by 1.10. Zones 5, 6, 7, 11 and 90 were factored by 1.05, and zone 49 by 0.95.

The adjusted internal trips were separated into three purposes--home based work (HBW), 23%; non-home based (NHB), 22%; and other home based (OHB), 55%. The NHB trips generated by external traffic was assumed to be the same percent as that generated by the internal origins.

The Sandhills area is important to the economy in the county and, therefore, the number of secondary internal (NHB) trips attributable to external-internal traffic was figured to be 7709 in the base year. That is, vehicles garaged outside the planning area making external-internal trips were assumed to be making 7709 trips per day while within the study area (e.g. to go to lunch, stop by the store, etc.). Distribution of these trips within the study area was made by merging them with the internally produced NHB trips on a pro rata basis and distributing them according to each zone's relative attractiveness.

F. 1987 INTERNAL TRIP ATTRACTIONS

The trip attraction factors for home based work trips were assumed to be total employment within the zones. Trip attraction factors for other home based trips and non-home based trips were assumed to be identical and were determined using the following regression equation modified from the previous thoroughfare plan study:

$$\mathbf{Y} = 23 + 1.24\mathbf{X}_1 + 4.74\mathbf{X}_2 + 3.86\mathbf{X}_3 + 1.70\mathbf{X}_4 + 2.79\mathbf{X}_5 + 1.07\mathbf{X}_6$$

factor	**SIC codes Y** = Attraction
$\mathbf{X}_1$ = Industrial	1-49
$\mathbf{X}_2$ = Retail	50-54, 56, 57, 59
$\mathbf{X}_3$ = Highway Retail	55, 58
$\mathbf{X}_4$ = Services	70-76, 78-89, 99
$\mathbf{X}_5$ = Office and Institutional	60-67, 91-97
$\mathbf{X}_6$ = All Dwelling Units	

This equation forces the plot through the origin. This method is theoretically correct and only a little correlation is sacrificed. This analysis yields a relative attraction factor that must then be factored to match productions. Zone attractions were also adjusted to match productions. Zones 82, 85, 86, 87, 90, 91, 92, 93, 95 and 96 were factored by 1.20. All zones internal trips were factored by 1.10. Zone 43 was factored by 0.95. Zones 92 and 93 were factored by 1.05.

G. TRIP DISTRIBUTION

The gravity model trip distribution program was used to distribute internal trips. Data input into this program included:

1. zone-to-zone travel times obtained from minimum time paths for the 1987 major street network;
2. zonal trip productions and attractions; and
3. friction factors from calibrated trip length frequency curves.

H. 1987 EXTERNAL-INTERNAL AND THROUGH TRIPS

Traffic counts were taken specifically for this study at 18 stations along the cordon of the planning area. Through and external-internal trip percentages were based on previous study data.

I. TRAFFIC ASSIGNMENT

Assignment techniques are based on certain variables such as travel time, distance, and cost. The most widely used factor is the time it takes to travel through a network. Traffic volumes were assigned to the network using a computer program which constructs minimum-time paths between zone centroids. The traffic was then loaded onto the network with capacity-restraint which loads the traffic gradually along the paths until any link on the path reaches its assigned capacity and then loads another path to that same zone centroid.

J. ACCURACY CHECKS

A traffic model was used to simulate existing traffic patterns. The accuracy of that simulation was tested along three screenlines of reference in the network. For each point at which a screenline crossed a street on the network a traffic count was taken. During calibration of the model the assigned traffic volumes were compared to the actual ground counts for those streets. The results of the accuracy checks are in Table A-3. The screenlines appear on the zone map in Figure A-1.

K. 2010 TRAVEL DESIRES

The calibrated traffic model was used to determine the impact future travel desires in the year 2010 would have on the major road network for the area. This impact was compared to the impact the existing 1987 travel desires have on the same network. The results of the comparison are in Table A-4.

TABLE A-3 SCREENLINE CHECK			
SCREENLINE	COUNT	MODEL	%ACCURACY
A	53936	52405	97
B	37298	41329	111
C	21368	17362	81
TOTAL	645442	616712	96

TABLE A-4 STUDY AREA INTERNAL TRIP DATA			
	1987	2010	% CHANGE
DWELLING UNITS	9642	18718	+ 94
POPULATION	23098	85507	+ 207
EMPLOYMENT	12885	23228	+ 80
INTERNAL TRIPS	46713	97504	+ 109
HOME BASED WORK	10740	22430	+ 109
HOME BASED OTHER	25690	53624	+ 109
NON-HOME BASED	17987	21454	+ 19
INTERNAL-EXTERNAL TRIPS	35043	64493	+ 84
THROUGH TRIPS	21269	34362	+ 62
TOTAL TRIPS	43144	78387	+ 82

L. 2010 INTERNAL TRIPS

The 2010 internal travel patterns were estimated using the same procedure as the base year travel patterns but socio-economic data projected to the year 2010 was used to determine the future year patterns. The local planning staffs provided the future year data. The trip productions and attractions were again distributed using the same gravity model. The trip generation rates were also the same. The internal data estimates are in Table A-5. The population estimates are in Table A-5. The employment estimates are in Table A-6.

M. 2010 EXTERNAL AND THROUGH TRIPS

External and through traffic volumes at the stations were projected to 2010 using adjusted historical trends. The results are in Table A-7. These trips were also distributed by the same method as 1987 trips.

TABLE A-5
INTERNAL DATA SUMMARY 2010

ZONE NO.	DWELLING UNITS EXC	AAV	AVG	BAV	LOW	SPE	COMMERCIAL TRK	AUT	UNADJ WORK ATTRS	UNADJ OTHER ATTRS
1		1	5	70	8		3		10	130
2	2	10	8	1				3	10	78
3	50	300	100	8	15		3	2	20	563
4	5	50	300	1			2	2	30	145
5	1	85	270	5						409
6		5	26	10					2	70
7		2	60	110	80		16		85	463
8	100	200	209				54	35	930	2617
9	200	56					18	6	93	458
10							5	4	100	193
11	1	100	50	33			10		76	382
12							5	3	1181	2160
13	86	45	243	117			26	6	347	1376
14	56	10	120							222
15	100	330	88				6	3	20	611
16							9	2	14	45
17			70	75	1	1	10	1	120	578
18	6	7	17	10			3	1	102	466
19	10	25	25	10			4	1	15	148
20	519	1363	100				1	1	32	2198
21	220	332	100				6	2	28	775
22	7	10	67				2		13	150
23	10	15	45	15			3	2	31	237
24	20	25	15				3	2	32	144
25	6	94							32	187
26	5	45								77
27	2	20	5	1	13		2	1		67
28			36	53	9		14		159	550
29			16	2						42
30							3		35	78
31		15	126				8	4	136	626
32		1	76	43			8	6	400	1125
33	10	121	80				7	3	110	599
34	20	230	156				7		59	553
35	24	134	80				2		16	339
36	1	16	16	1			4	5	45	154
37	4	7	123	36				5	152	357
38		1	12	2						39
39	1	2	18	21	3				2	80
40		2	103	5			7	3	64	253
41			22	11	3		22	9	335	1032
42	1	17	64	37	4					155
43	1	17	25				19	2	470	868
44	16	183	122					24	60	463
45	2	73	53	28			6	3	38	251

TABLE A-5
INTERNAL DATA SUMMARY 2010

ZONE NO.	DWELLING UNITS EXC	AAV	AVG	BAV	LOW	SPE	COMMERCIAL TRK	AUT	UNADJ WORK ATTRS	UNADJ OTHER ATTRS
46	2		45	81	6	1	8	3	182	502
47		29	117	258	92		22	16	581	1884
48	20	311	224				3	1	51	705
49			269	31			1		48	523
50			37	19			66	13	445	1186
51			16	44	5		24	16	444	1358
52		1	49	22	5	1	19	14	408	1058
53			35	83	2		11		155	735
54			257	39			12	5	189	879
55		43	95	70			11	4	162	741
56		23	54	5	10		4	5	39	203
57			4				131	9	1799	2437
58	3	2	2		20		5		6	59
59		5	26	7			1	1	21	100
60			5				1		4	35
61	1		6							30
62	2	5	11	1			3	2	8	57
63			32	25	10		6		15	114
64			112	57						204
65		4	128	121			15	29	211	950
66	2	19	84	3		1	1	46	205	488
67	29	15	18	2			10	2	20	125
68	20									44
69	1	14	10	1						51
70		3	3				8		8	48
71	1	44	12							84
72	4	66	68	3						174
73	12	36	162	26	1		27	22	449	1324
74	3	24	70	1	1		2		149	382
75		58	66	3						159
76		48	63	3						145
77	2	59	131	11			8	4	8	254
78	11	91	88							226
79		8	150				5	10	100	570
80			175							210
81	1	5	150							190
82	1	2	250							294
83			35	10						71
84	2	15	110							159
85	2	1	25	5					175	394
86	3	5	45	10						90
87			60	5			5	5		93
88			15	10			50	10	690	1192
89			25	150			25	10	365	715
90			25	55	5				15	133

TABLE A-5
INTERNAL DATA SUMMARY 2010

ZONE NO.	DWELLING UNITS EXC	AAV	AVG	BAV	LOW	SPE	COMMERCIAL TRK	AUT	UNADJ WORK ATTRS	UNADJ OTHER ATTRS
91			30	35	5		50	5	435	1049
92	1	1	10				20	5	550	893
93			35	150			50	10	150	407
94		1	45	50						126
95			10	10			60	10	295	1102
96		1	40	15			75	35	545	1681
97		2	30				25	15	335	1092
98		1	150				25	10	535	1865
99			7	52			12	6	508	1960
100		1	68	51			61	12	964	3346
101		14	11	10			28	12	428	1368
102	20	228	152				28	1	567	2417
103		30	70						78	293
104	101	40							60	279
105		4					30	26	355	962
106			250				35	10	1070	4182
107	1	100	100							283
108			50	50				5	255	1047
109	3	4	30	95			100	35	865	1530
110		2	185	300					90	839
111			180	100			75	25	1635	3228
112		150	300				15	5	220	1023
113	100	20							179	440
114		100	250				35	20	445	1611
115			180	25			15		415	1524
TOTAL	1834	5584	8598	2809	298	4	1521	615	23335	78435

TABLE A-5
POPULATION

ZONE NO.	EXC	AAV	AVG	BAV	LOW	SPE	TOTAL
1		2	12	168	19		201
2	48	24	19	2			93
3	1200	720	240	19	36		2215
4	120	120	720	2			962
5	24	204	648	12			888
6		12	62	24			98
7		5	144	264	192		605
8	2400	480	502				3382
9	4800	134					4934
10							
11	24	240	120	79			463
12							
13	2064	108	583	281			3036
14	1344	24	288				1656
15	2400	792	211				3403
16							
17			168	180	2	2	352
18	144	17	41	24			226
19	240	60	60	24			384
20	2456	3271	240				5967
21	5280	797	240				6317
22	168	24	161				353
23	240	36	108	36			420
24	480	60	36				576
25	144	226					370
26	120	108					228
27	48	48	12	2	31		141
28			86	127	22		235
29			38	5			43
30							
31		36	302				338
32		2	182	103			287
33	240	290	192				722
34	480	552	374				1406
35	576	322	192				1090
36	24	38	38	2			102
37	96	17	295	86			494
38		2	29	5			36
39	24	5	43	50	7		129
40		5	247	12			264
41			53	26	7		86
42	24	41	154	89	10		318
43	24	41	60				125
44	384	439	293				1116
45	48	175	127	67			417
46	48		108	194	14	2	366

TABLE A-5
POPULATION

ZONE NO.	EXC	AAV	AVG	BAV	LOW	SPE	TOTAL
47		70	281	619	221		1191
48	480	746	538				1764
49			646	74			720
50			89	46			135
51			38	106	12		156
52		2	118	53	12	2	187
53			84	199	5		288
54			617	94			711
55		103	228	168			499
56		55	130	12	24		221
57			10				10
58	72	5	5		48		130
59		12	62	17			91
60			12				12
61	24		14				38
62	48	12	26	2			88
63			77	60	24		161
64			269	137			406
65		10	307	290			607
66	48	46	202	7		2	305
67	696	36	43	5			780
68	480						480
69	24	34	24	2			84
70		7	7				14
71	24	106	29				159
72	96	158	163	7			424
73	288	86	389	62	2		827
74	72	58	168	2	2		302
75		139	158	7			304
76		115	151	7			273
77	48	142	314	26			530
78	264	218	211				693
79		19	360				379
80			420				420
81	24	12	360				396
82	24	5	600				629
83			84	24			108
84	48	36	264				348
85	48	2	60	12			122
86	72	12	108	24			216
87			144	12			156
88			36	24			60
89			60	360			420
90			60	132	12		204
91			72	84	12		168
92	24	2	24				50

TABLE A-5
POPULATION

ZONE NO.	EXC	AAV	AVG	BAV	LOW	SPE	TOTAL
93			84	360			444
94		2	108	120			230
95			24	24			48
96		2	96	36			134
97		5	72				77
98		2	360				362
99			17	125			142
100		2	163	122			287
101		34	26	24			84
102	480	547	365				1392
103		72	168				240
104	2424	96					2520
105		10					10
106			600				600
107	24	240	240				504
108			120	120			240
109	72	10	72	228			382
110		5	444	720			1169
111			432	240			672
112		360	720				1080
113	2400	48					2448
114		240	600				840
115			432	60			492
TOTAL	44016	13400	20633	6736	714	8	85507

OCCUPANCY RATES					
EXC	AAV	AVG	BAV	LOW	SPE
2.4	2.4	2.4	2.4	2.4	2.4

TABLE A-5
TRIPS BY UNIT

ZONE NO.	TRIPS BY DWELLING UNITS						AUTO TRIPS	TRK TRIPS	COMM AUTO TRIPS	TOTAL TRIPS
	EXC	AAV	AVG	BAV	LOW	SPE				
1		7	24	196	14		241	20		261
2	19	71	38	3			131		20	151
3	480	2130	470	22	26		3128	20	13	3161
4	48	355	1410	3			1816	13	13	1842
5	10	604	1269	14			1897			1897
6		36	122	28			186			186
7		14	282	308	136		740	107		847
8	960	1420	982				3362	362	235	3959
9	1920	398					2318	121	40	2479
10								34	27	61
11	10	710	235	92			1047	67		1114
12								34	20	54
13	826	320	1142	328			2616	174	40	2830
14	538	71	564				1173			1173
15	960	2343	414				3717	40	20	3777
16								60	13	73
17			329	210	2	1	542	67	7	616
18	58	50	80	28			216	20	7	243
19	96	178	118	28			420	27	7	454
20	4982	9677	470				15129	7	7	15143
21	2112	2357	470				4939	40	13	4992
22	67	71	315				453	13		466
23	96	107	212	42			457	20	13	490
24	192	178	71				441	20	13	474
25	58	667					725			725
26	48	320					368			368
27	19	142	24	3	22		210	13	7	230
28			169	148	15		332	94		426
29			75	6			81			81
30								20		20
31		107	592				699	54	27	780
32		7	357	120			484	54	40	578
33	96	859	376				1331	47	20	1398
34	192	1633	733				2558	47		2605
35	230	951	376				1557	13		1570
36	10	114	75	3			202	27	34	263
37	38	50	578	101			767		34	801
38		7	56	6			69			69
39	10	14	85	59	5		173			173
40		14	484	14			512	47	20	579
41			103	31	5		139	147	60	346
42	10	121	301	104	7		543			543
43	10	121	118				249	127	13	389
44	154	1299	573				2026		161	2187
45	19	518	249	78			864	40	20	924

TABLE A-5
TRIPS BY UNIT

ZONE NO.	TRIPS BY DWELLING UNITS EXC	AAV	AVG	BAV	LOW	SPE	AUTO TRIPS	TRK TRIPS	COMM AUTO TRIPS	TOTAL TRIPS
46	19		212	227	10	1	469	54	20	543
47		206	550	722	156		1634	147	107	1888
48	192	2208	1053				3453	20	7	3480
49			1264	87			1351	7		1358
50			174	53			227	442	87	756
51			75	123	9		207	161	107	475
52		7	230	62	9	1	309	127	94	530
53			165	232	3		400	74		474
54			1208	109			1317	80	34	1431
55		305	447	196			948	74	27	1049
56		163	254	14	17		448	27	34	509
57			19				19	878	60	957
58	29	14	9		34		86	34		120
59		36	122	20			178	7	7	192
60			24				24	7		31
61	10		28				38			38
62	19	36	52	3			110	20	13	143
63			150	70	17		237	40		277
64			526	160			686			686
65		28	602	339			969	101	194	1264
66	19	135	395	8		1	558	7	308	873
67	278	107	85	6			476	67	13	556
68	192						192			192
69	10	99	47	3			159			159
70		21	14				35	54		89
71	10	312	56				378			378
72	38	469	320	8			835			835
73	115	256	761	73	2		1207	181	147	1535
74	29	170	329	3	2		533	13		546
75		412	310	8			730			730
76		341	296	8			645			645
77	19	419	616	31			1085	54	27	1166
78	106	646	414				1166			1166
79		57	705				762	34	67	863
80			823				823			823
81	10	36	705				751			751
82	10	14	1175				1199			1199
83			165	28			193			193
84	19	107	517				643			643
85	19	7	118	14			158			158
86	29	36	212	25			305			305
87			282	14			296	34	34	364
88			71	28			99	335	67	501
89			118	420			538	168	67	773
90			118	154	9		281			281

TABLE A-5
TRIPS BY UNIT

ZONE NO.	TRIPS BY DWELLING UNITS EXC	AAV	AVG	BAV	LOW	SPE	AUTO TRIPS	TRK TRIPS	COMM AUTO TRIPS	TOTAL TRIPS
91			141	98	9		248	335	34	617
92	10	7	47				64	134	34	232
93			165	420			585	335	67	987
94		7	212	140			359			359
95			47	28			75	402	67	544
96		7	188	42			237	503	235	975
97		14	141				155	168	101	424
98		7	705				712	168	67	947
99			33	146			179	80	40	299
100		7	320	143			470	109	80	959
101		99	52	28			179	188	80	447
102	192	1619	714				2525	188	7	2720
103		213	329				542			542
104	970	284					1254			1254
105		28					28	201	174	403
106			1175				1175	235	67	1477
107	10	710	470				1190			1190
108			235	140			375		34	409
109	29	28	141	266			464	670	235	1369
110		14	870	840			1724			1724
111			846	280			1126	503	168	1797
112		1065	1410				2475	101	34	2610
113	960	142					1102			1102
114		710	1175				1885	235	134	2254
115			846	70			916	101		1017
TOTAL		39649		7867		4		10199		120381
	17611		40419		509		106059		4123	

AUTO TRIPS / DU

EXC	AAV	AVG	BAV	LOW	SPE
9.6	7.1	4.7	2.8	1.7	.5

TRUCK TRIPS/TRUCK 6.7
COMM AUTO TRIPS/ COMM AUTO 6.7

TABLE A-5
TRIPS BY PURPOSE

ZONE NO.	INTRL TRIPS	HOME WORK TRIPS	OTHER HOME TRIPS	NON HOME INTRL	ADJST WORK ATTRS	ADJST OTHER ATTRS	ADJST NON-H ATTRS
1	211	49	116	46	10	89	59
2	122	28	67	27	10	53	35
3	2560	589	1408	563	19	385	256
4	1492	343	821	328	29	99	66
5	1537	354	845	338		279	186
6	151	35	83	33	2	48	32
7	686	158	377	151	82	316	210
8	3207	738	1764	706	894	1787	1188
9	2008	462	1104	442	89	313	208
10	49	11	27	11	96	132	88
11	902	207	496	198	73	261	173
12	44	10	24	10	1135	1475	981
13	2292	527	1261	504	333	940	625
14	950	219	523	209		152	101
15	3059	704	1682	673	19	417	277
16	59	14	32	13	13	31	20
17	499	115	274	110	115	395	262
18	197	45	108	43	98	318	212
19	368	85	202	81	14	101	67
20	12266	2821	6746	2699	31	1501	998
21	4044	930	2224	890	27	529	352
22	377	87	207	83	12	102	68
23	397	91	218	87	30	162	108
24	384	88	211	84	31	98	65
25	587	135	323	129	31	128	85
26	298	69	164	66		53	35
27	186	43	102	41		46	30
28	345	79	190	76	153	376	250
29	66	15	36	15		29	19
30	16	4	9	4	34	53	35
31	632	145	348	139	131	428	284
32	468	108	257	103	384	768	511
33	1132	260	623	249	106	409	272
34	2110	485	1161	464	57	378	251
35	1272	293	700	280	15	232	154
36	213	49	117	47	43	105	70
37	649	149	357	143	146	244	162
38	56	13	31	12		27	18
39	140	32	77	31	2	55	36
40	469	108	258	103	62	173	115
41	280	64	154	62	322	705	469
42	440	101	242	97		106	70
43	315	72	173	69	452	593	394
44	1771	407	974	390	58	316	210
45	748	172	411	165	37	171	114

TABLE A-5
TRIPS BY PURPOSE

ZONE NO.	INTRL TRIPS	HOME WORK TRIPS	OTHER HOME TRIPS	NON HOME INTRL	ADJST WORK ATTRS	ADJST OTHER ATTRS	ADJST NON-H ATTRS
46	440	101	242	97	175	343	228
47	1529	352	841	336	558	1287	855
48	2819	648	1550	620	49	482	320
49	1100	253	605	242	46	357	237
50	612	141	337	135	428	810	538
51	385	89	212	85	427	928	617
52	429	99	236	94	392	723	480
53	384	88	211	84	149	502	334
54	1159	267	637	255	182	600	399
55	850	196	468	187	156	506	336
56	412	95	227	91	37	139	92
57	775	178	426	171	1729	1664	1106
58	97	22	53	21	6	40	27
59	156	36	86	34	20	68	45
60	25	6	14	6	4	24	16
61	31	7	17	7		20	14
62	116	27	64	26	8	39	26
63	224	52	123	49	14	78	52
64	556	128	306	122		139	93
65	1024	236	563	225	203	649	431
66	707	163	389	156	197	333	222
67	450	104	248	99	19	85	57
68	156	36	86	34		30	20
69	129	30	71	28		35	23
70	72	17	40	16	8	33	22
71	306	70	168	67		57	38
72	676	155	372	149		119	79
73	1243	286	684	273	431	904	601
74	442	102	243	97	143	261	173
75	591	136	325	130		109	72
76	522	120	287	115		99	66
77	944	217	519	208	8	173	115
78	944	217	519	208		154	103
79	699	161	384	154	96	389	259
80	667	153	367	147		143	95
81	608	140	334	134		130	86
82	971	223	534	214		201	133
83	156	36	86	34		48	32
84	521	120	287	115		109	72
85	128	29	70	28	168	269	179
86	247	57	136	54		61	41
87	295	68	162	65		64	42
88	406	93	223	89	663	814	541
89	626	144	344	138	351	488	325
90	228	52	125	50	14	91	60

TABLE A-5
TRIPS BY PURPOSE

ZONE NO.	INTRL TRIPS	HOME WORK TRIPS	OTHER HOME TRIPS	NON HOME INTRL	ADJST WORK ATTRS	ADJST OTHER ATTRS	ADJST NON-H ATTRS
91	500	115	275	110	418	716	476
92	188	43	103	41	529	610	405
93	799	184	439	176	144	278	185
94	291	67	160	64		86	57
95	441	101	243	97	283	753	500
96	790	182	435	174	524	1148	763
97	343	79	189	75	322	746	496
98	767	176	422	169	514	1274	847
99	242	56	133	53	488	1339	890
100	777	179	427	171	926	2285	1519
101	362	83	199	80	411	934	621
102	2203	507	1212	485	545	1651	1097
103	439	101	241	97	75	200	133
104	1016	234	559	224	58	191	127
105	326	75	179	72	341	657	437
106	1196	275	658	263	1028	2856	1899
107	964	222	530	212		193	128
108	331	76	182	73	245	715	475
109	1109	255	610	244	831	1045	695
110	1396	321	768	307	86	573	381
111	1456	335	801	320	1571	2205	1466
112	2114	486	1163	465	211	699	464
113	893	205	491	196	172	301	200
114	1826	420	1004	402	428	1100	731
115	824	190	453	181	399	1041	692
TOTAL	97504	22430	53624	21454	22425	53571	35607

TRIP PERCENTAGE	
INTERNAL OF TOTAL	81
HOME BASED WORK OF INTERNAL	23
OTHER HOME BASED OF INTERNAL	55
NON HOME BASED OF INTERNAL	22

TABLE A-6
EMPLOYMENT BY STANDARD INDUSTRIAL CODE 2010

ZONE	INDUSTRY	RETAIL HIGHWAY	RETAIL OTHER	WAREHOUSE & SERVICE	OFFICE	DU's
1	0	0	0	10	0	84
2	0	5	0	5	0	21
3	0	0	0	20	0	473
4	0	0	0	20	10	56
5	0	0	0	0	0	361
6	0	0	0	2	0	41
7	10	10	0	65	0	252
8	10	70	40	650	160	509
9	0	0	0	90	3	256
10	0	0	0	100	0	0
11	0	8	0	60	8	184
12	6	15	0	1080	80	0
13	23	58	28	228	10	491
14	0	0	0	0	0	186
15	0	0	0	20	0	518
16	4	0	0	10	0	0
17	5	45	20	35	15	147
18	4	60	20	15	3	40
19	0	7	0	5	3	70
20	0	0	0	32	0	1982
21	5	3	0	20	0	652
22	2	3	2	3	3	84
23	0	15	10	4	2	85
24	0	0	0	30	2	60
25	0	0	0	30	2	100
26	0	0	0	0	0	50
27	0	0	0	0	0	41
28	0	50	0	109	0	98
29	0	0	0	0	0	18
30	27	0	0	0	8	0
31	0	50	28	50	8	141
32	0	75	25	290	10	120
33	0	50	0	50	10	211
34	9	0	0	50	0	406
35	0	7	6	3	0	238
36	35	10	0	0	0	38
37	0	0	35	10	0	170
38	0	0	0	0	0	15
39	0	2	0	0	0	45
40	8	0	3	53	0	110
41	50	100	50	125	10	36
42	0	0	0	0	0	123
43	0	0	0	470	0	43
44	10	0	0	50	0	321
45	8	0	0	30	0	156

TABLE A-6
EMPLOYMENT BY STANDARD INDUSTRIAL CODE 2010

ZONE	INDUSTRY	RETAIL HIGHWAY	RETAIL OTHER	WAREHOUSE & SERVICE	OFFICE	DU's
46	3	6	0	164	9	134
47	0	100	3	449	29	496
48	0	0	0	50	1	555
49	0	5	35	2	6	300
50	107	61	73	156	48	56
51	43	97	43	130	131	65
52	52	37	54	215	40	77
53	14	53	66	0	22	120
54	0	50	25	104	10	296
55	0	50	25	75	12	208
56	10	5	0	19	5	92
57	1741	50	0	8	0	4
58	6	0	0	0	0	27
59	0	0	0	21	0	38
60	0	0	0	4	0	5
61	0	0	0	0	0	7
62	0	0	0	8	0	19
63	15	0	0	0	0	67
64	0	0	0	0	0	169
65	11	57	40	64	39	253
66	0	0	0	205	0	108
67	0	0	0	20	0	64
68	0	0	0	0	0	20
69	0	0	0	0	0	26
70	0	0	0	3	5	6
71	0	0	0	0	0	57
72	0	0	0	0	0	141
73	71	40	58	217	63	237
74	0	0	0	149	0	99
75	0	0	0	0	0	127
76	0	0	0	0	0	114
77	0	0	0	8	0	203
78	0	0	0	0	0	190
79	20	50	30	0	0	158
80	0	0	0	0	0	175
81	0	0	0	0	0	156
82	0	0	0	0	0	253
83	0	0	0	0	0	45
84	0	0	0	0	0	127
85	130	25	10	10	0	33
86	0	0	0	0	0	63
87	0	0	0	0	0	65
88	600	75	0	0	15	25
89	350	15	0	0	0	175
90	15	0	0	0	0	85

TABLE A-6
EMPLOYMENT BY STANDARD INDUSTRIAL CODE 2010

ZONE	INDUSTRY	RETAIL HIGHWAY	RETAIL OTHER	WAREHOUSE & SERVICE	OFFICE	DU's
91	250	75	30	50	30	70
92	50	50	0	0	0	12
93	150	0	0	0	0	185
94	0	0	0	0	0	96
95	75	180	15	15	10	20
96	100	150	45	100	150	56
97	50	100	35	50	100	32
98	50	110	200	150	25	151
99	25	208	172	86	17	59
100	104	326	266	233	35	120
101	3	150	50	200	25	25
102	0	333	45	189	0	300
103	0	0	0	50	28	100
104	0	0	0	60	0	141
105	33	82	40	190	10	4
106	25	500	175	200	170	250
107	0	0	0	0	0	201
108	0	125	40	75	15	100
109	700	50	20	75	20	132
110	20	30	25	10	5	487
111	1200	150	70	150	75	280
112	150	70	0	0	0	450
113	120	13	0	46	0	120
114	0	70	100	250	25	350
115	175	175	50	0	15	205

TABLE A-7
STATION VOLUME PROJECTIONS

STATION #	DESCRIPTION	1987	2010
130	Taylortown Rd	315	711
131	Murdocksville Rd	1215	2740
132	US 15-501 North	4690	7735
133	NC 22 North	3813	6290
134	Airport Rd	2684	5297
135	Niagara	1024	2021
136	George Blue Rd	360	710
137	US 1 North	9569	15433
138	Youngs Rd	1065	2625
139	Connecticut Ave	1490	2629
140	NC 211 South	8491	14325
141	US 15-501 South	5267	8688
142	US 1 South	6539	10546
143	Needham Grove Rd	1597	3152
144	Roseland Rd	1244	2455
145	Maness Orchard Rd	1006	2372
146	Chicken Plant Rd	254	626
147	NC 211 North	5689	10499

APPENDIX B -- RECOMMENDED DEFINITIONS AND DESIGN STANDARDS FOR SUBDIVISION ORDINANCES

Definitions:

Streets and Roads:

Rural Roads:

Principal Arterials

A rural link in a system of continuous routes serving corridor movements having trip length and travel density characteristics indicative of substantial statewide or interstate travel and existing solely to serve traffic. This system would consist of Interstate routes and other routes designated as principal arterials.

Minor Arterials

A rural link in a network joining cities and larger towns and providing intrastate and inter-county service at relatively high overall travel speeds with minimum interference to through movement.

Major Collector

A road which serves major intracounty travel corridors and traffic generators and provides access to the Arterial system.

Minor Collector

A road which provides service to small local communities and links the local-ly important traffic generators with their rural hinterland.

Local Road

A local road that serves primarily to provide access to adjacent land and for travel over relatively short distances.

Urban Streets:

Major Thoroughfares

Major thoroughfares consist of Interstate, other freeway, express-way, or parkway links, and major streets that provide for the expeditious movement of high volumes of traffic within and through urban areas.

Minor Thoroughfares

Minor thoroughfares are important streets in the city system and perform the function of collecting traffic from local access streets and carrying it to the major thoroughfare system. Minor thoroughfares may be used to supplement the major thoroughfare system by facilitating a minor through-traffic movement and may also serve abutting property.

Local Street

A local street is any link not on a higher-order urban system and serves pri-marily to provide direct access to abutting land and access to higher systems.

Specific Type Rural or Urban Street:

Freeway, Expressway, or Parkway

Divided multi-lane roadways designed to carry large volumes of traffic at relatively high speeds. A **freeway** is a divided highway providing for continuous flow of vehicles with no direct access to abutting property or streets and with access to selected crossroads provided via connecting ramps. An **expressway** is a divided highway with full or partial control of access and generally with grade separations at major inter-sections. A **parkway** is a highway for non-commercial traffic, with full or partial control of access, and usually located within a park or a ribbon of park-like development.

Residential Collector Street

A local access street which serves as a connector street between local residential streets and the thor-oughfare system. They typically collect traffic from 100 to 400 dwelling units.

Local Residential Street

Cul-de-sacs, loop streets less than 2500 feet in length, or streets less than one mile in length that do not connect thoroughfares, or serve major traffic generators, and do not collect traffic from more than 100 dwelling units.

Cul-de-sac

A short street having but one end open to traffic and the other end being perma-nently terminated and a vehicular turnaround provided.

Frontage Road

A local street or road that is parallel to a full or partial access controlled facility and functions to provide access to adjacent land.

Alley

A strip of land, owned publicly or privately, set aside primarily for vehicular service access to the back side of properties otherwise abutting on a street.

Property:

Building Setback Line:

A line parallel to the street in front of which no structure shall be erected.

Easement:

A grant by the property owner for use by the public, a corporation, or person(s), of a strip of land for a specific purpose.

Lot:

A portion of a subdivision, or any other parcel of land, intended as a unit for transfer of ownership or for development or both. The word "lot" includes the words "plat" and "parcel".

Corner Lot

A lot abutting upon two streets at their intersection.

Double-Frontage Lot

A continuous (through) lot which is accessible from

both of the parallel streets upon which it fronts.

Reverse-Frontage Lot

A continuous through lot which is accessible from only one of the parallel streets upon which it fronts.

Subdivision:

Subdivider

Any person, firm, corporation or official agent thereof, who subdivides or develops any land deemed to be a subdivision.

Subdivision

Divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, whether immediate or future, of sale or building development, and all divisions of land involving the dedication of a new street or change in existing streets; provided, however, that the following shall not be included within this definition nor subject to these regulations: (1) the combination or recombination of portions of previously platted lots where the total number of lots is not increased and the resultant lots are equal to or exceed the standards contained herein; (2) the division of land into parcels greater than ten acres where no street right-of-way dedication is involved, (3) the public acquisition by purchase of strips of land for the widening or opening of streets; (4) the division of a tract in single ownership whose entire area is no greater than two acres into not more than three lots, where no street right-of-way dedication is involved and where the resultant lots are equal to or exceed the standards contained herein.

Dedication:

A gift, by the owner, of his property to another party without any consideration being given for the transfer. Since a transfer of property is involved, the dedication is made by written instrument and is completed with an acceptance.

Reservation:

A reservation of land does not involve any transfer of property rights. It simply constitutes an obligation to keep property free from development for a stated period of time.

Design Standards:

The design of all State maintained streets and roads within the Town shall be in accordance with the accepted policies of the North Carolina Department of Transportation, Division of Highways, as taken or modified from the American Association of State Highway and Transportation Officials' (AASHTO) manuals.

The provision of street rights-of-way shall conform and meet the requirements of the thoroughfare plan for the Town as adopted by the Town and the North Carolina Department of Transportation.

The proposed street layout shall be coordinated with the existing street system of the surrounding area. Normally the proposed streets should be the extension of existing streets if possible.

The urban planning area shall consist of that area within the urban planning boundary as depicted on the mutually adopted thoroughfare plan. the rural planning area shall be that area outside the urban planning boundary.

Right-of-Way Widths:

Right-of-way widths shall not be less than the following and shall apply except in those cases where right-of-way requirements have been specifically set out in the Thoroughfare Plan.

TABLE B-1
MINIMUM RIGHT-OF-WAY

Rural	
Principal Arterial	
Freeways	350
Other	200
Minor Arterial	100
Major Collector	100
Minor Collector	100
Local Road	60
Urban	
Major Thoroughfare Other Than Freeway or Expressway	90
Minor Thoroughfare	70
Local Street	60
Cul-de-sac	Variable

The desirable minimum right-of-way is 60 feet. If curb and gutter is provided, 50 feet of right-of-way is adequate on local residential streets. The subdivider will only be required to dedicate a maximum of 100 feet of right-of-way. In cases where over 100 feet of right-of-way is desired, the subdivider will be required only to reserve the amount in excess of 100 feet. On all cases in which right-of-way is sought for an access controlled facility, the subdivider will only be required to make a reservation. The right-of-way dimension for a cul-de-sac will depend on the radius used for vehicular turnaround. Distance from edge of pavement of turnaround to right-of-way should not be less than distance form edge of pavement to right-of-way on street approaching turnaround.

A partial width right-of-way, not less than sixty (60) feet in width, may be dedicated when adjoining undeveloped property that is owned or controlled by the subdivider; provided that the width of a partial dedication be such as to permit the installation of

such facilities as may be necessary to serve abutting lots. When the said adjoining property is subdivided, the remainder of the full required right-of-way shall be dedicated.

Street Widths:

Widths for street and road classifications other than local shall be as required by the Thoroughfare Plan. Width of local roads and streets shall be as follows:

Local Residential

Curb and gutter section 26 feet, to face of curb Shoulder section 20 feet to edge of pavement, 4 foot shoulders.

Residential Collector

Curb and gutter section 34 feet, face to face of curb. Shoulder section 20 feet to edge of pavement, 6 foot shoulders.

Geometric Characteristics:

The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway system or Municipal Street System. In cases where a subdivision is sought adjacent to a proposed thoroughfare corridor, the requirements of dedication and reservation discussed under Right-of-Way shall apply.

Design Speeds

TABLE B-2
SUBDIVISION DESIGN SPEEDS (MPH)

	Desirable	(Minimum) Level	Rolling	Mountainous
Rural				
Minor Collector Roads	60	(50)	(40)	(30)
Local Roads including Residential Collectors and Local Residential	50	(50)*	(40)*	(30)*
Urban				
Major Thoroughfares Other than Freeway or Expressway	60	(50)	(50)	(50)
Minor Thoroughfares	60	(50)	(50)	(40)
Local Streets	40	(40)**	(30)**	(20)**

*Based on projected annual average daily traffic of 400-750. In cases where road will serve a very limited area and small number of dwelling units, minimum design speeds can be reduced further.
**Based on projected annual average daily traffic of 50-250.

Maximum and Minimum Grades

TABLE B-3 MAXIMUM GRADES (%)			
Design Speed	Level	Rolling	Mountainous
60 (mph)	2	4	6
50	4	5	7
40	5	6	8
30		9	10
20			12

A minimum grade for curbed streets normally should not be less than 0.5%, a grade of 0.35% may be allowed where there is a high type pavement accurately crowned and in areas where special drainage conditions may control. Grades for 100 feet each way from intersections should not exceed 5%. For streets and roads with projected annual average daily traffic less than 250, short grades less than 500 feet long, may be 150% greater.

Minimum Sight Distances

In the interest of public safety, no less than the minimum sight distance applicable shall be provided in every instance. Vertical curves that connect each change in grade shall be provided and calculate using the following parameters. General practice calls for vertical curves to be multiples of 50 feet. Calculated lengths shall be rounded up in each case:

TABLE B-4 MINIMUM SIGHT DISTANCES					
Design Speed, MPH	20	30	40	50	60
Stopping Sight Distance					
Minimum, ft.	150	200	275	350	475
Desired, ft.	150	200	300	450	650
Min. K* Value For:					
Min. Crest Curve	16	28	55	85	160
Des. Crest Curve	16	28	65	145	300
Min. Sag Curve	24	35	55	75	105
Des. Sag Curve	24	35	60	100	155
Passing Sight Distance					
Minimum, ft. (2 lane)		1100	1500	1800	2100
Min. K* Value For Crest Vertical Curve		365	686	985	1340

*K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length in feet of the vertical curve which will provide minimum sight distance.

Sight distance provided for stopped vehicles at intersections should be in accordance with "A Policy on Geometric Design of Highways and Streets, 1984". The following table shows the maximum degree of curve and related maximum superelevation (e) for rural roads with no curb and gutter is .08. The maximum rate of superelevation for urban streets with curb and gutter is .06 with .04 being desirable.

TABLE B-5
MAXIMUM DEGREE OF CURVE AND SUPERELEVATION

Design Speed MPH	Maximum e*	Minimum Radius (Rounded) Feet	Maximum Degree of Curve (Rounded) Feet
20	.04	125	45.0
30	.04	300	19.0
40	.04	560	10.0
50	.04	925	6.0
60	.04	1410	4.0
20	.06	115	50.0
30	.06	275	21.0
40	.06	510	11.0
50	.06	830	7.0
60	.06	1260	4.5
20	.08	110	53.5
30	.08	250	23.0
40	.08	460	12.5
50	.08	760	7.5
60	.08	1140	5.0

*e = rate of roadway superelevation, foot per foot

Intersections:

Streets shall be laid out so as to intersect as nearly as possible at right angles, and no street should intersect any other street at an angle less than sixty (60) degrees. Property lines at intersections should be set so that the distance from the edge of pavement, of the street turnout, to the property line will be at least as great as the distance from the edge of pavement to the property line along intersecting streets. This property line can be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for the stopped vehicle on the side street. Off-set intersections are to be avoided unless exception is granted by the Division of Highways for intersections involving the State Highway System, or the Planning Board for intersections involving only the municipal street

system. Intersections which cannot be aligned should be separated by a minimum length of 200 feet between survey centerlines.

Cul-de-sacs:

Cul-de-sacs, unless exception is granted by the local planning board, shall not be more than five hundred (500) feet in length. The distance from the edge of pavement on the vehicular turnaround to the right-of-way line should not be less than the distance from the edge of pavement to the right-of-way lone on the street approaching the turnaround. Cul-de-sacs should not be used to avoid connection with an existing street or to avoid the extension of an important street.

Alleys:

Alleys shall be required to serve lots used for commercial and industrial purposes except that this requirement may be waived where other definite and assured provision is made for service access. Alleys shall not be provided in residential subdivisions unless necessitated by unusual circumstances. The width of an alley shall be at least twenty (20) feet. Deadend alleys shall be avoided where possible, but if unavoidable, shall be provided with adequate turnaround facilities at the deadend as may be approved by the Planning Board. Sharp changes in alignment and grade shall be avoided.

Permits For Connection To State Roads:

An approved permit is required for connection to any existing state system road. This permit is required prior to any construction on the street or road. the application is available at the office of the nearest District Engineer of the Division of Highways.

Offsets To Utility Poles:

Poles for overhead utilities should be located clear of roadway shoulders, preferably a minimum of at least 30 feet from the edge of pavement. In streets with curb and gutter, utility poles shall be set back a minimum distance of 6 feet from the face of curb.

Wheel Chair Ramps:

In accordance with Chapter 136, Article 2A, Section 136-44.14, all street curbs in North Carolina being constructed or reconstructed for maintenance purposed, traffic operations, repairs, correction of utilities, or altered for any reason after September 1, 1973, shall provide wheelchair ramps for the physically handicapped at all intersections where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow. Wheelchair ramps and depressed curbs shall be constructed in accordance with details contained in the Department of Transportation, Division of Highways, Publication entitled, "Guidelines, Curb Cuts and Ramps for Handicapped Persons".

Horizontal Width on Bridge Deck:

The clear roadway widths for new and reconstructed bridges serving 2 lane, 2 way traffic should be:

Shoulder Section Approach

Under 800 ADT Design Year

Minimum 28 feet width face to face of parapets or rails, or pavement width plus 10 feet, whichever is greater.

800-2000 ADT Design Year

Minimum 34 feet width face to face of parapets or rails, or pavement width plus 12 feet, whichever is greater.

Over 2000 ADT Design Year

Minimum 40 feet, but desirable 44 feet width face to face of parapets or rails.

Curb and Gutter Approach

Where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height, in width of face to face of curbs, and in crown drop. The distance from face of curb to face of parapet or rail shall be 1'6" minimum, or greater if sidewalks are required.

Under 800 ADT Design Year

Minimum 24 feet face to face of curbs.

Over 800 ADT Design Year

Width of approach pavement measured face to face of curbs.

The clear roadway widths for new and reconstructed bridges having 4 or more lanes serving undivided two-way traffic should be as follows:

Shoulder Section Approach

Width of approach pavement plus width of usable shoulders on the approach left and right.

Minimum 8 feet

Design 10 feet

Curb and Gutter Approach

Width of approach pavement measured face to face of curbs.

APPENDIX C -- RECOMMENDED STREET DESIGN AND SYSTEM INDEX

A. TYPICAL CROSS SECTIONS

Figure C-1 contains a selection of cross sections used for Thoroughfare Plan recommendations. Typical pavement widths and right-of-way widths are shown.

Cross section "A" is typical for controlled access freeways. The forty-six-foot grassed median is the minimum desirable median width but there could be some variation because of design considerations. Slopes of 8:1 into three-foot drainage ditches are desirable for traffic safety. Right-of-way widths would typically vary upward from 250 feet depending upon location cut and fill requirements.

Cross section "B" is typical for four-lane divided highways in rural areas which may have only partial or no control of access. The minimum median width for this cross section is thirty feet, but a wider median ins desirable. Design requirements for slopes and drainage would be similar to cross section "A", with some variation due to right-of-way constraints.

Cross section "C", seven-lane urban, and cross section "D", five-lane urban, are typical for major thoroughfares where frequent left turns are anticipated as a result of abutting development or frequent street intersections.

Cross sections "E" and "F" are used for major thoroughfares where left turns and intersecting streets are not as frequent. Left turns would be restricted to a few selected intersections.

Cross section "G" is recommended for urban boulevards or parkways to enhance the urban environment and to improve the compatibility of major thoroughfares with residential areas. A minimum median width of twenty-four feet is recommended with thirty feet being desirable.

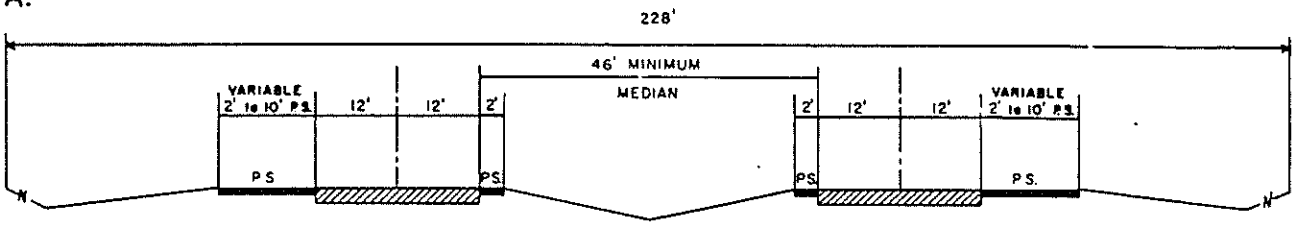
Typical section "H" is recommended for major thoroughfares where projected travel indicates a need for four lanes but traffic is not excessively high, left turning movements are light, and right-of-way is restricted. An additional left turn lane would probably be required at major intersections.

Thoroughfares which are proposed to function as one-way traffic carriers would require cross section "I". Cross sections "J" and "K" are recommended for minor thoroughfares since these facilities usually serve both land service and traffic service functions. Cross section "J" would be used on those minor thoroughfares where parking on both sides is needed as a result of more intense development.

Cross section "L" is used in rural areas or for staged construction of a wider multilane cross section. On some thoroughfares projected traffic volumes may indicate that two travel lanes will adequately serve travel for a considerable period of time.

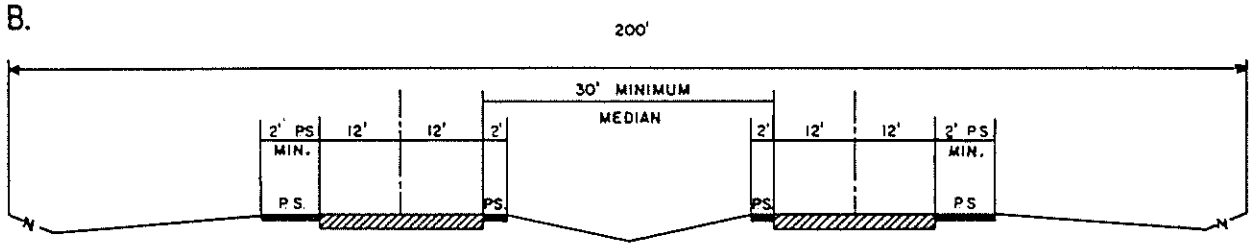
TYPICAL THOROUGHFARE CROSS SECTIONS

A.



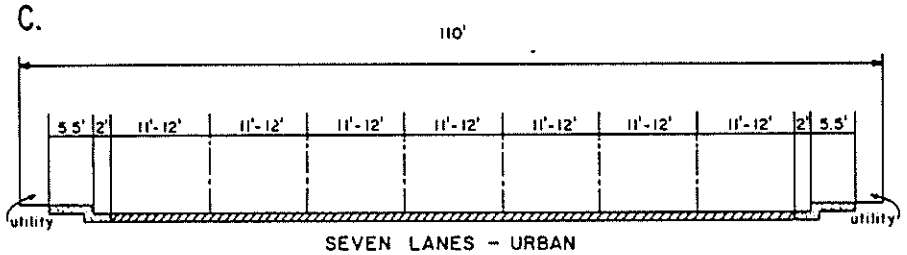
FOUR LANES DIVIDED WITH MEDIAN - FREEWAY

B.



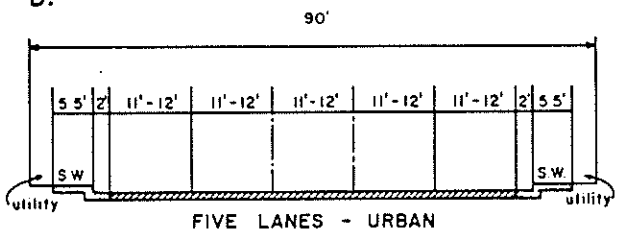
FOUR LANES DIVIDED WITH MEDIAN - RURAL

C.



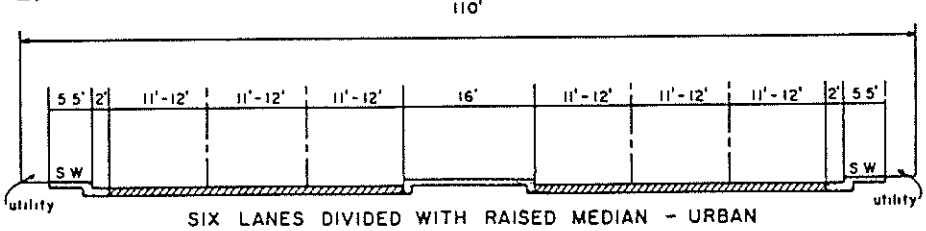
SEVEN LANES - URBAN

D.



FIVE LANES - URBAN

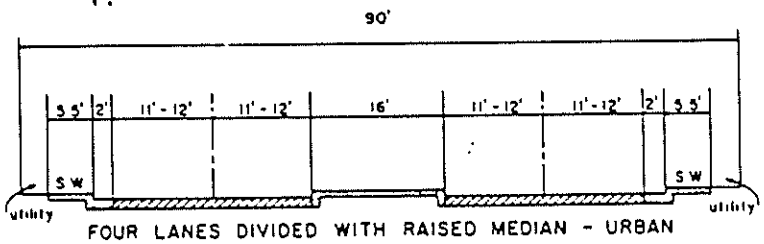
E.



SIX LANES DIVIDED WITH RAISED MEDIAN - URBAN

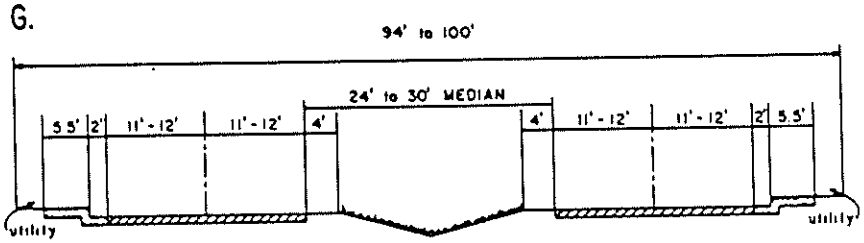
TYPICAL THOROUGHFARE CROSS SECTIONS
(CONTINUED)

F.



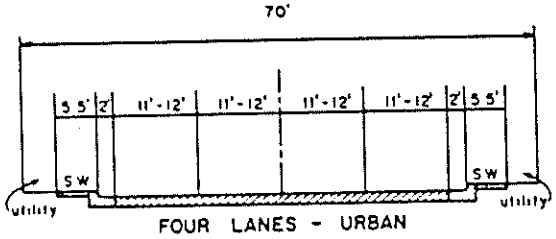
FOUR LANES DIVIDED WITH RAISED MEDIAN - URBAN

G.



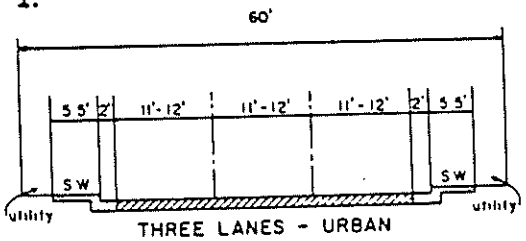
FOUR LANES DIVIDED - URBAN BOULEVARD
GRASS MEDIAN

H.



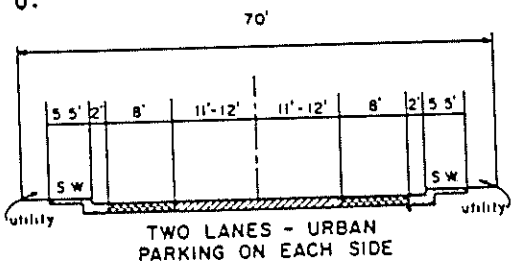
FOUR LANES - URBAN

I.



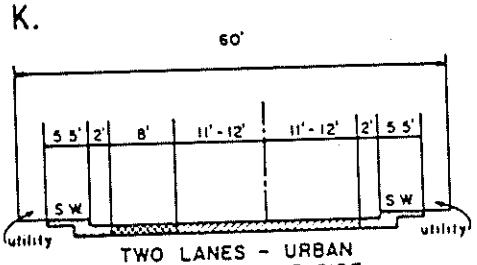
THREE LANES - URBAN

J.



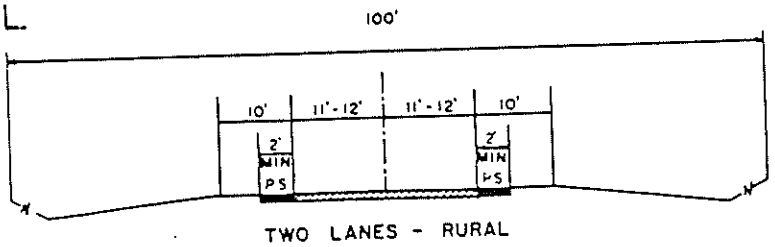
TWO LANES - URBAN
PARKING ON EACH SIDE

K.



TWO LANES - URBAN
PARKING ON ONE SIDE

L.



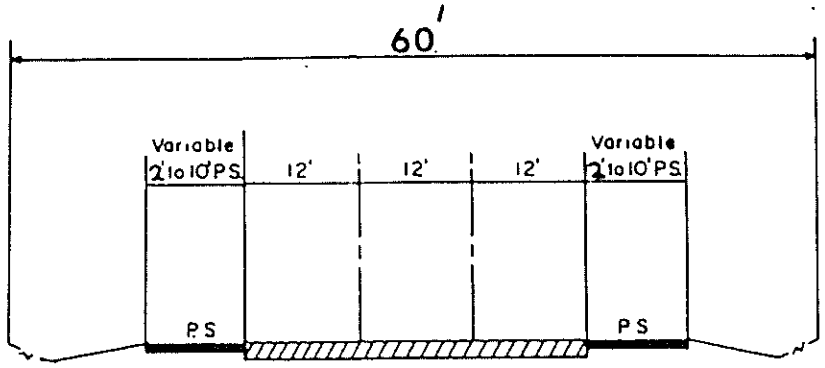
TWO LANES - RURAL

FIGURE C-1 CONT.

TYPICAL THOROUGHFARE CROSS SECTIONS

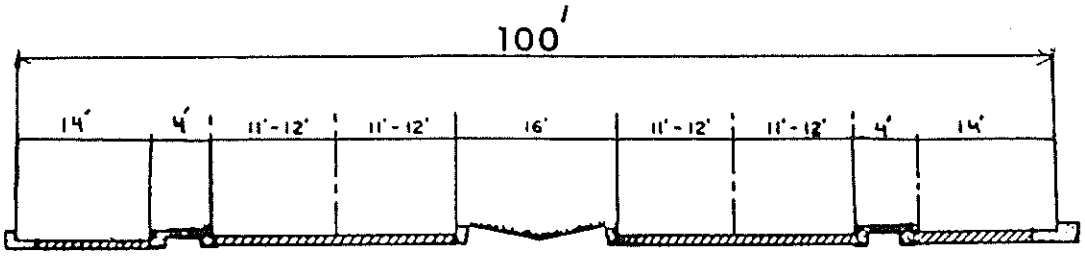
(CONTINUED)

M



THREE LANE RURAL

N



FOUR LANE DIVIDED WITH SERVICE ROADS
AND GRASS MEDIAN

Cross sections "M" and "N" are recommended specifically for the Southern Pines-Aberdeen-Pinehurst Thoroughfare Plan. Much of the Sandhills area is rural and a curb-and-gutter is not practicable. On those sections of road where three lanes are necessary section "M" is recommended. Cross section "N" is recommended for that section of US 1 between the NC 211 bypass in Aberdeen and Broad Street in Southern Pines.

The curb-and-gutter urban cross sections all show a sidewalk adjacent to the curb with a buffer or utility strip between the sidewalk and the minimum right-of-way line. This permits adequate setback for utility poles. If it is desired to move the sidewalk further away from the street to provide additional separation for pedestrians or for aesthetic reasons, additional right-of-way must be provided to insure adequate setback for utility poles.

Rights-of-way shown for the typical cross sections are the minimum required to contain the street, sidewalks, utilities, and drainage facilities. Cut and fill requirements may require either additional right-of-way or construction easements. Obtaining construction easements is becoming the more common practice for urban thoroughfare construction.

If there is sufficient bicycle travel along the thoroughfare to justify a bicycle lane or bikeway, additional right-of-way may be required to contain bicycle facilities. The North Carolina Bicycle Facility and Program Handbook* should be consulted for design standards for bicycle facilities.

B. DESIGN REQUIREMENTS

Design requirements for thoroughfares vary according to the desired capacity and level of services 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 amount and type of projected traffic, existing capacity, desired level of service, and available right-of-way.

Recommended typical cross sections for thoroughfares were derived on the basis of projected traffic, existing capacities, desirable levels of service and available right-of-way.

On all existing and proposed major thoroughfares delineated on the thoroughfare plan, it is recommended that adequate right-of-way be protected or acquired for the ultimate cross sections. The ultimate desirable cross sections for the thoroughfares are listed in the table. Recommendations for "ultimate' cross sections are provided for (1) thoroughfares which may require widening after the current planning period; (2) for thoroughfares which are borderline adequate and accelerated traffic growth could render them deficient; and (3) for thoroughfares where an urban curb and gutter cross section may be locally desirable because of urban development or redevelopment.

Recommended design standards relating to maximum and minimum grades, minimum sight distances, maximum degree of curve and related superelevation, and other considerations for thoroughfares

are given in Appendix B. Appendix B gives definitions and design standards recommended for inclusion in subdivision regulations.

* **The North Carolina Bicycle Facility and Program Handbook** , Barton-Aschman Associates, Inc., April, 1975.

C. LEVEL OF SERVICE CAPACITY

Capacity and Level of Service are terms used to describe how a road handles the traffic it carries. Capacity is defined as the maximum number of vehicles which has a reasonable expectation of passing over a given section of road during a given time period under prevailing roadway and traffic conditions. The most common units used for capacity is vehicles per day. Level of Service describes the relationship between the capacity of a road and the volume of traffic that road is forced to carry. Six levels are used to decribe the service a road under various speed and volume conditions. They are:

Level of Service A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the thaffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian are excellent.

Level of Service B is in the range of stable flow, but the presence of the other users in the traffic stream begins to be noticable. Freedom to select desired speeds is relatively unaffected, but there is a slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A because the presence of others in the traffic stream begins to affect individual behavior.

Level of Service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

Level of Service D represents high-density, but stable flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small encreases in traffic flow will generally cause operational problems at this level.

Level of Service E represents operation conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform, value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accomodate such maneuvers. Comfort and convenience levels are extremely poor, and

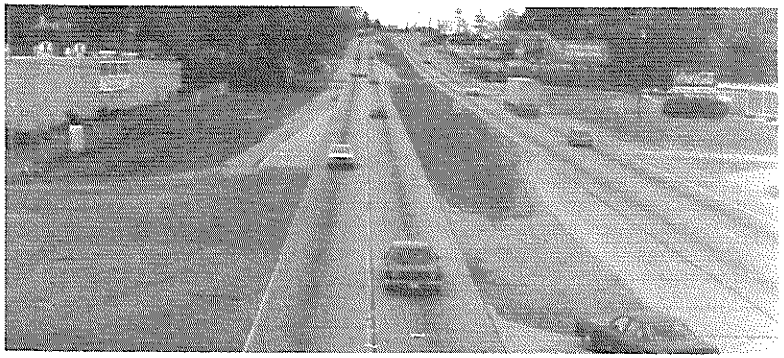
driver or pedestrian frustration is generally high. operations at this level are usually unstable, because small increases in flow or minor perterbations within the traffic stream will cause breakdowns.

Level of Service F is used to define forced or brakedown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go waves, and they are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level of Service F is used to describe the operating conditions within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases operating conditions of vehicles or pedestrians discharged from the queue may be quite good. Neverthless, it is the point at which arrival flow exceeds discharge flow which causes the queue to form, and level of service F is an appropriate designation for such points.

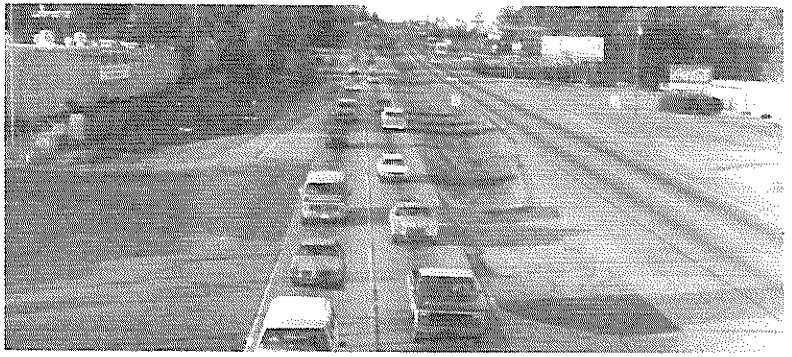
Generally, Level of Service D is accepted by the planning profession as the "practical capacity" of a highway and an urban facility operating below that level of service is operating below tolerance. Figure C-2 is a pictorial illustration of the above definitions.

D. STREET SYSTEM INDEX

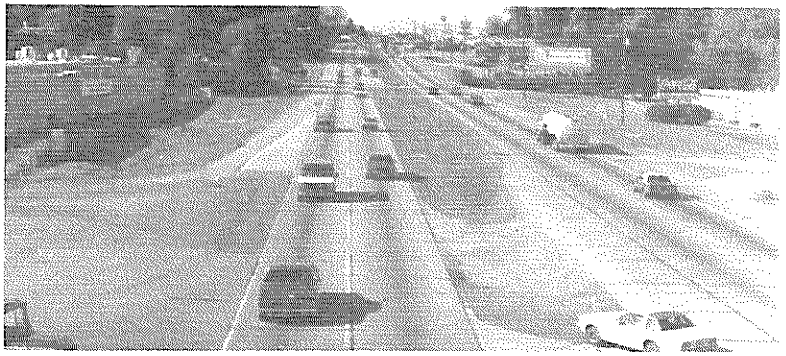
Table C-1 contains a detailed listing of all the streets on the Southern Pines-Aberdeen-Pinehurst Thoroughfare Plan and the recommended right-of-way widths and thoroughfare cross sections for each.



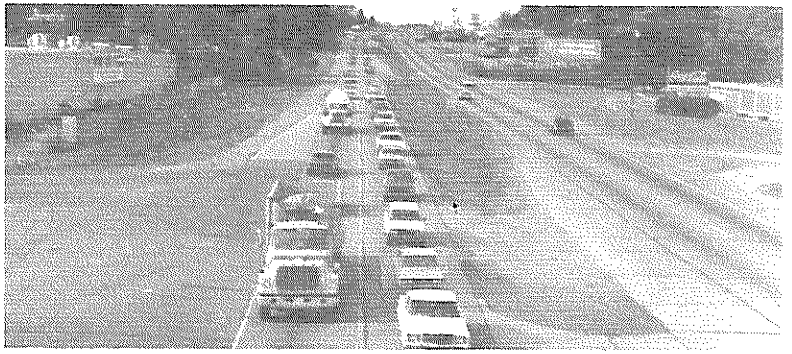
LEVEL OF SERVICE - A



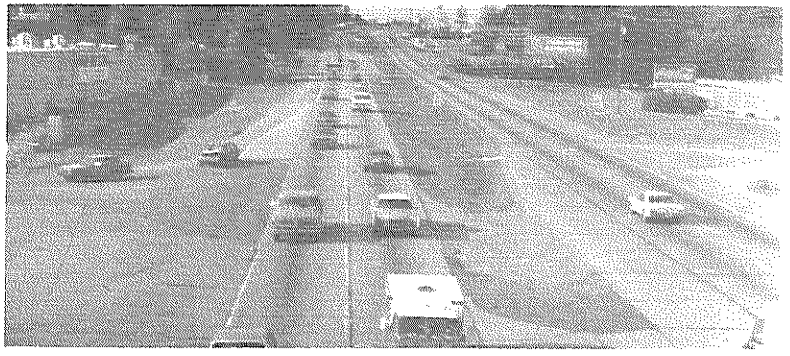
LEVEL OF SERVICE - D



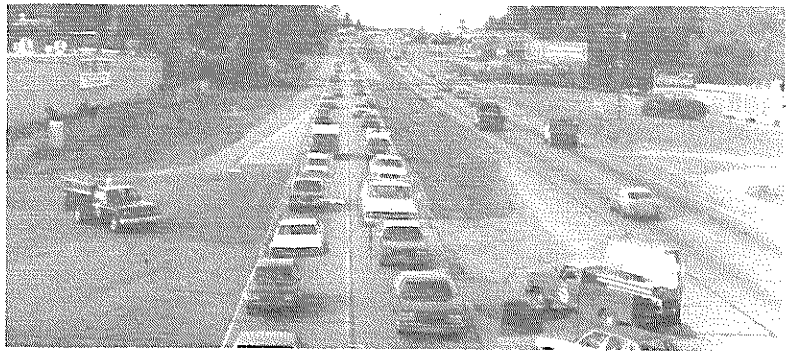
LEVEL OF SERVICE - B



LEVEL OF SERVICE - E



LEVEL OF SERVICE - C



LEVEL OF SERVICE - F

LEVELS OF SERVICE

FIGURE C-2

TABLE C-1 -- STREET SYSTEM INDEX

SECTION	PRESENT					FUTURE			
	DIST (MI)	RDWY (FT)	ROW (FT)	CAP (VEH)	1987 ADT	CAP (VEH)	2010 ADT	RDWY (X)	ROW (FT)
Aiken Rd(SR 1853)									
NC 22-George Blue	0.40	20	60	6500		6500	1300	ADQ	ADQ
Airport Rd(SR 1843)									
NC 2-Knoll Rd	1.68	22	60	8000	3100	8000	5200	ADQ	ADQ
Knoll-NC 22	1.81	22	60	8000	4000	10000	7800	M	ADQ
NC 22-STBNDY	1.10	24	60	9600	2700	8000	5200	ADQ	ADQ
Azalea Rd(NC 2)									
Cherokee-Palmetto	0.21	22	60	6500		6500	9400	(L)	(60)
Ashe St									
Mass Ave-Vermont Ave	0.50	22	60	6500		6500	1000	ADQ	ADQ
Bethesda Rd(NC 5,SR 2042)									
Blue St-Old Pee Dee	0.41	20	60	6500	1300	6500	2500	ADQ	ADQ
Old Pee Dee-EL Ives	0.52	20	60	6500	1400	6500	2700	ADQ	ADQ
Ft Bragg-Indiana Ave	0.75	18	60	5000		5000	700	ADQ	ADQ
Indiana Ave-Connecticutt	1.02	18	30	5000		5000	300	ADQ	ADQ
E Broad St(SR 2116)									
Illinois-Indiana Ave	0.10	30	60	7500		7500	1000	ADQ	ADQ
Indiana Ave-Pennsylvania	0.30	30	60	7500		7500	1000	ADQ	ADQ
Pennsylvania-Connecticut	0.20	43	60	7500		7500	1600	ADQ	ADQ
Connecticutt-Vermont	0.10	30	60	7500		7500	1600	ADQ	ADQ
W Broad St(SR 2080,2053)									
US 1-Morganton Rd	0.52	43	100	9600	8146	9600	8400	ADQ	ADQ
Morganton Rd-Illinois	0.30	46	60	7500		7500	900	ADQ	ADQ
Illinois-Pennsylvania	0.39	43	60	7500		7500	900	ADQ	ADQ
Pennsylvania-Vermont	0.30	30	60	7500	4121	7500	1500	ADQ	ADQ
Vermont-Midland	0.46	43	60	15000		15000	1300	ADQ	ADQ
Buelah Hill Rd(NC 5)									
NC 211-Linden North	0.68	20	60	6500	3000	6500	1600	ADQ	ADQ
Linden North-Cherokee	0.38	20	60	6500	5100	6500	5500	ADQ	ADQ
Central Dr(NC 22)									
Midland-Pee Dee Rd	0.98	22	60	8000	4700	11000	8200	M	ADQ
Cherokee Rd(NC 2)									
Beulah Hill-Azalea Rd	0.18	20	60	6500	6500	6500	9800	(L)	(60)
Chicken Plant Rd(SR 1121)									
STBNDY-Linden Rd North	1.63	22	60	8000	250	8000	600	ADQ	ADQ
Clark St(SR 2032)									
Midland-Yadkin	0.80	24	60	9600	150	9600	400	ADQ	ADQ
Connecticutt Ave(SR 2033)									
W Broad-May St	0.14	30	40	8200		8200	1000	ADQ	ADQ
May St-Highland Rd	0.55	30	40	8200	1420	8200	1000	ADQ	ADQ
Highland Rd-Bethesda Rd	0.50	24	60	9600	685	9600	1600	ADQ	ADQ
Bethesda Rd-STBNDY	1.90	24	60	9600		9600	1600	ADQ	ADQ

TABLE C-1 -- STREET SYSTEM INDEX

SECTION	PRESENT					FUTURE			
	DIST (MI)	RDWY (FT)	ROW (FT)	CAP (VEH)	1987 ADT	CAP (VEH)	2010 ADT	RDWY (X)	ROW (FT)
Delaware Ave									
May-Youngs	0.10	22	36	8200		8200	3500	ADQ	ADQ
Fairway Dr(SR 1854)									
Central-Aiken Rd	0.41	20	60	6500		6500	2000	ADQ	ADQ
Fort Bragg Rd(SR 2074)									
EL Ives Rd-Saunders	0.97	20	60	6500	2300	6500	2800	ADQ	ADQ
Saunders-Bethesda	0.43	20	60	6500		6500	4000	ADQ	ADQ
Bethesda-Indiana	0.75	24	60	9600	805	9600	2900	ADQ	ADQ
Indiana-Connecticutt	2.34	24	60	9600		9600	1500	ADQ	ADQ
George Blue Rd(SR 1853)									
Aiken-Niagara	1.93	20	60	6500	1060	6500	800	ADQ	ADQ
Niagara-STBNDY	0.57	20	60	6500	360	6500	800	ADQ	ADQ
Glasgow St(SR 2066)									
Poindexter-Raeford Rd	0.42	18	60	8000	370	8000	1700	ADQ	ADQ
Raeford Rd-South St	0.25	18	60	5000		5000	2300	ADQ	ADQ
South-Bethesda Rd	0.22	18	40	6500		6500	2900	ADQ	ADQ
Green Ave(SR 1110)									
Roseland-End	0.5	--	--	--		10000	2300	L	60
End-NC 5	0.30	20	60	5000		10000	2300	L	60
Gun Club Rd									
NC 211-Springlake Dr	0.46	22	60	8000		8000	900	ADQ	ADQ
Highland Rd									
Indiana-Connecticutt	0.45	24	60	6500	115	6500	600	ADQ	ADQ
Indiana Ave(SR 2036,2075)									
E Broad-Morganton	0.63	22	40	8000	3958	8000	1700	ADQ	ADQ
Morganton-Bethesda	0.76	22	40	8000	2750	8000	2800	ADQ	ADQ
Bethesda-Ft Bragg	0.60	24	40	9600		9600	2200	ADQ	ADQ
Ft Bragg-Raeford Rd	2.62	22	60	6500	2200	6500	2300	ADQ	ADQ
Juniper Lake Rd(SR 1216)									
NC 211-Taylortown	0.92	20	60	6500		6500	1400	ADQ	ADQ
Taylortown-Richmond	0.83	20	60	6500		6500	900	ADQ	ADQ
Richmond-Murdocsville	0.28	20	60	6500		6500	1000	ADQ	ADQ
Murdocsville-US 15-501	1.85	20	60	6500	370	6500	5800	ADQ	ADQ
Kelly Rd									
Midland-Rattlesnake Tr	0.48	20	40	6500		6500	600	ADQ	ADQ
Knoll Rd									
Pinecr Sch-Midland Rd	1.08					11000	7800	L	60
Midland Rd-Airport Rd	1.05	36	80	15000		15000	7700	ADQ	ADQ
Knoll Rd Ext									
Airport Rd-US 15-501	2.16	--	--	----		10000	3100	L	60

TABLE C-1 -- STREET SYSTEM INDEX

SECTION	PRESENT DIST (MI)	PRESENT RDWY (FT)	PRESENT ROW (FT)	PRESENT CAP (VEH)	PRESENT 1987 ADT	FUTURE CAP (VEH)	FUTURE 2010 ADT	FUTURE RDWY (X)	FUTURE ROW (FT)
Linden Rd North(SR 1115)									
Maness Or-Chicken Plant	0.52	22	60	6500	1516	8000	1700	ADQ	ADQ
Chicken Plant-McKensie	1.26	22	60	8000	3000	8000	4100	ADQ	ADQ
McKensie-Buelah Hill	0.28	22	60	8000		8000	3100	ADQ	ADQ
Linden Rd South(SR 1115)									
Maness-NC 5	3.66	22	60	8000	280	8000	400	ADQ	ADQ
Maness Orch Rd(SR 1122)									
STBNDY-Linden Rd South	1.16	20	60	6500	1000	6500	3000	ADQ	ADQ
Linden Rd S-Linden Rd N	0.27	20	60	6500		6500	3200	ADQ	ADQ
May St(SR 2080)									
Morganton-Indiana Ave	0.30	22	60	8000	1905	8000	4400	ADQ	ADQ
Indiana-Pennsylvania	0.30	22	60	8000		8000	6100	ADQ	ADQ
Penn Ave-Conn Ave	0.20	22	60	8000		8000	6800	ADQ	ADQ
Connecticutt-Delaware	0.48	30	60	8200		8200	6700	ADQ	ADQ
Delaware-Yadkin	0.88	30	60	8200		8200	2000	ADQ	ADQ
Yadkin-Niagara	0.60	24	60	9600		9600	1300	ADQ	ADQ
Niagara-US 1	1.60	24	60	9600	900	9600	600	ADQ	ADQ
McKensie Rd(SR 1209)									
Murdocksville-Buelah Hl	0.45	18	60	5000	668	5000	1300	ADQ	ADQ
Buelah Hill-Linden North	0.32	18	60	5000		5000	1100	ADQ	ADQ
Linden North-Cherokee	0.69	18	60	5000		5000	6000	ADQ	ADQ
Midland Rd(NC 2,SR 2035)									
Kelly Rd-Circle	0.72	60	60	20000	5100	20000	13600	ADQ	ADQ
Circle-Airport Rd	0.29	68	120	28000	10000	28000	15900	ADQ	ADQ
Airport Rd-Pee Dee	2.61	68	120	24000	6500	24000	10200	ADQ	ADQ
Pee Dee-Central	0.90	62	120	22000	5000	22000	7700	ADQ	ADQ
Central-US 1	0.15	62	120	22000	8200	22000	15900	ADQ	ADQ
US 1-W Broad St	0.83	62	90	20000		20000	6900	ADQ	ADQ
Morganton Rd(SR 1309, SR 2105, SR 1205)									
NC 5-Montecello	1.03	20	60	6500	4339	6500	4300	ADQ	ADQ
Montecello-CCNC	0.70	20	60	6500		6500	11600	M	60
CCNC-US 15-501	0.67	20	90	6500		24000	14700	F	90
US 15-501-Pinecrest Sch	0.27	20	90	6500		24000	14500	F	90
Pinecrest School-US 1	1.30	24	90	9600	7820	24000	11900	G	100
US 1-W Broad St	0.31	42	60	12000	9123	24000	8000	G	100
W Broad St-May St	0.20	24	60	10000		10000	10000	ADQ	ADQ
May St-Indiana	0.56	30	40	8200		8200	3400	ADQ	ADQ
Murdocksville Rd(SR 1209)									
STBNDY-Juniper Lake	0.69	20	60	6500	1215	6500	2700	ADQ	ADQ
Juniper Lake-NC 211	1.42	20	60	6500		6500	2000	ADQ	ADQ
NC 211-McKensie	0.25	20	60	6500		6500	1300	ADQ	ADQ
Murry Hill Rd(SR 1204)									
US 15-501-US 1	0.75	20	60	8000	2126	11000	6300	I	60

TABLE C-1 -- STREET SYSTEM INDEX

SECTION	PRESENT					FUTURE			
	DIST (MI)	RDWY (FT)	ROW (FT)	CAP (VEH)	1987 ADT	CAP (VEH)	2010 ADT	RDWY (X)	ROW (FT)
Needham Grove Rd(SR 1103)									
STBDY-NC211 Bypass	0.31	18	60	5000	1600	5000	3100	ADQ	ADQ
NC211 Bypass-NC5	1.24	18	60	5000		5000	4000	ADQ	ADQ
New York Ave									
W Broad-E Broad	0.05	42	60	5000		8200	2200	ADQ	ADQ
Niagara Rd(SR 1802,1857)									
May St-George Blue	2.80	18	60	8000	900	8000	2700	ADQ	ADQ
George Blue St-STBNDY	0.56	18	60	6500	1023	6500	2000	ADQ	ADQ
NC 5									
Cherokee-Morganton	0.52	22	60	8000	10000	8000	10500	(M)	(60)
Morganton-Linden Rd S	1.72	22	60	8000	6600	8000	12500	(M)	(60)
Linden Rd S-Needham Gr	1.06	22	60	8000	6357	15000	12100	M	60
Needham Gr-Sandhls Blvd	2.41	22	60	8000	9000	15000	16100	M	60
NC 22									
STBNDY-Airport Ent.	1.15	20	60	8000	3814	8000	6300	ADQ	ADQ
Airport Ent.-Airport Rd	0.58	20	60	8000		11000	8500	M	60
Airport Rd-Pee Dee Rd	1.79	20	60	8000	4700	11000	8500	M	60
NC 211									
STBNDY-NC 211 Bypass	0.39	24	100	9600	5689	9600	10200	(D)	(100
Bypass-Juniper Lake	0.15	24	100	9600		9600	6000	ADQ	ADQ
Juniper Lake-Beulah Hl	1.94	24	100	9600	5900	8100	4900	ADQ	ADQ
Buelah Hl-Murdocksvle	0.37	24	60	9600	5300	9600	6600	ADQ	ADQ
Murdocksville-Gun Club	0.63	24	60	9600		9600	8900	ADQ	ADQ
Gun Club-Page Rd	0.58	24	60	9600		9600	8500	ADQ	ADQ
Page Rd-Circle	0.30	24	60	10000	10100	10000	14000	(M)	(60)
Page Rd(SR 1208)									
Midland Rd-NC 211	0.50	24	60	9600		9600	2700	ADQ	ADQ
NC 211-US 15-501	0.53	24	60	9600	4241	9600	8000	ADQ	ADQ
Pee Dee Rd(SR 1848)									
Midland Rd-NC 22	1.01	20	60	6500		6500	3700	ADQ	ADQ
Palmetto Rd(NC 2)									
Azalea Rd-Kelly Rd	0.44	24	60	10000	6500	10000	14600	(M)	(60)
Pennsylvania Ave(SR 1848)									
Midland Rd-US 1	1.37	60	80	15000		15000	6500	ADQ	ADQ
US 1-W Broad St	0.47	60	80	20000	8500	20000	4400	ADQ	ADQ
W Broad St-May St	0.23	24	60	15000		15000	3500	ADQ	ADQ
Pinecrest Sch Rd(SR 1901, 1905)									
US 15-501-Morganton Rd	1.41	28	60	8200	7564	8200	900	ADQ	ADQ
Pinehurst Bypass									
NC 211-Chicken Plant Rd	1.88	--	--	--		11000	6200	B	200
Chicken Pl-Maness Orch	0.66	--	--	--		11000	6500	B	200
Maness Orch-Needham Gr	4.20	--	--	--		11000	10100	B	200

TABLE C-1 -- STREET SYSTEM INDEX

SECTION	PRESENT DIST (MI)	PRESENT RDWY (FT)	PRESENT ROW (FT)	PRESENT CAP (VEH)	PRESENT 1987 ADT	FUTURE CAP (VEH)	FUTURE 2010 ADT	FUTURE RDWY (X)	FUTURE ROW (FT)
Poindexter St(US 15-501)									
Sandhlls Blvd-Raeford Rd	0.22	60	60	24500	8000	24500	12600	ADQ	ADQ
Raeford Rd-Glasgow St	0.41	24	60	9600	6000	9600	12500	(M)	(60)
Poplar St(SR 2055)									
South St-Main St	0.10	30	60	8200	2100	8200	2200	ADQ	ADQ
Main St-Maple St	0.17	30	60	8200	2258	8200	5900	ADQ	ADQ
Maple St-Johnson St	1.67	30	60	8200		8200	100	ADQ	ADQ
Johnson St-US 1	0.31	20	60	6500	2249	6500	2300	ADQ	ADQ
Rattlesnake Tr									
Kelly Rd-NC 211	0.30	22	60	8000	2434	8000	700	ADQ	ADQ
Raeford Rd(NC 211)									
Poindexter-Old Pee Dee	0.95	24	60	9600	4100	20000	8900	H	70
Old Pee Dee-Saunders Ext	0.83	24	60	9600	6290	20000	11900	H	70
Saunders Ext-Indiana	0.87	24	60	9600		20000	11100	H	70
Richmond St(SR 1214)									
Taylortown-Juniper Lake	0.67	18	60	5000	235	5000	100	ADQ	ADQ
Roseland Rd(SR 1112)									
STBNDY-NC211 Bypass	0.20	20	60	6500		6500	2500	ADQ	ADQ
NC211 Bypass-Green St	1.72	20	60	6500	1244	20000	13200	H	100
Green St-Pinehurst St	0.65	20	60	6500	1610	20000	15500	H	100
Pinehurst-US 1	0.20	20	60	6500		20000	11400	H	100
US 1-NC 211	0.25	--	--	--		20000	9800	H	70
Sandhills Blvd(US 1)									
Poindexter St-South St	0.17	48	100	33500	14600	33500	24300	N	ADQ
South St-Main St	0.13	60	100	24000	15000	40000	37700	N	ADQ
Main St-US 15-501	1.48	60	100	24000	26500	40000	45400	N	ADQ
Saunders Blvd(SR 2053)									
US1-Ft Bragg	1.24	22	60	8000	3300	12000	11800	I	ADQ
Saunders Blvd Ext									
Fort Bragg-NC 211	1.89	--	--	--		10000	9400	M	60
South St(SR 2064)									
Sandhls Blvd-Sycamore	0.12	39	60	10000	4800	10000	6600	ADQ	ADQ
Sycamore St-Raeford	0.60	24	60	9600	2480	9600	3800	ADQ	ADQ
Spring Lake Dr									
Gun Club Dr-US 15-501	1.07	24	60	9600	289	9600	200	ADQ	ADQ
Taylortown Rd(SR 1210)									
STBNDY-Juniper Lake	0.90	18	60	6500	315	6500	700	ADQ	ADQ
Juniper Lake-Richmond	0.72	18	60	6500		6500	700	ADQ	ADQ
Richmond-NC 211	0.89	18	60	6500		8000	1500	ADQ	ADQ

TABLE C-1 -- STREET SYSTEM INDEX

SECTION	PRESENT					FUTURE			
	DIST (MI)	RDWY (FT)	ROW (FT)	CAP (VEH)	1987 ADT	CAP (VEH)	2010 ADT	RDWY (X)	ROW (FT)
US 1									
STBNDY-NC211 Bypass	1.69	48	150	33500	6539	33500	10000	ADQ	ADQ
NC211-Poindexter	0.41	48	150	33500		33500	9200	N	ADQ
US 15-501-Murray Hill	0.75	72	100	30000	20000	40000	29500	N	ADQ
Murray Hill-Broad St	0.13	72	100	30000	26600	40000	38300	N	ADQ
Broad St-Morganton	0.43	48	100	40000	12800	40000	30200	ADQ	ADQ
Morganton-Penn Ave	0.81	48	100	40000	17000	40000	35500	ADQ	ADQ
Penn Ave-Midland	1.08	48	100	40000	12000	40000	25800	ADQ	ADQ
Midland-May	2.58	48	100	40000	9100	40000	18500	ADQ	ADQ
May-STBDRY	0.85	48	260	33500	9568	33500	12800	ADQ	ADQ
US 15-501									
STBNDY-#6 entrance	1.61	24	100	9600	4691	9600	6000	ADQ	ADQ
#6 entrance-Page Rd	0.28	24	100	9600		9600	9400	ADQ	ADQ
Page Rd-Circle	0.57	24	100	9600	5400	9600	7400	ADQ	ADQ
Circle-#7 entrance	0.64	48	150	24000	10000	24000	23300	ADQ	ADQ
#7 entrance-Pinecr Sch	1.28	60	150	24000	14633	24000	23300	ADQ	ADQ
Pinecrest Sch-Morganton	0.50	60	150	24000		24000	24900	D	ADQ
Morganton-Murry Hill	0.91	64	150	28000	15600	28000	32300	D	ADQ
Murry Hill-US 1	0.85	64	150	28000	11000	28000	24000	ADQ	ADQ
Glasgow-STBNDY	1.00	24	100	9600	5267	9600	14200	M	ADQ
Vermont Ave									
W Broad-E Broad	0.03	42	60	5000		8200	2200	ADQ	ADQ
Yadkin Rd(SR 2029)									
US 1-May St	0.72	22	60	9600	2249	9600	4900	I	ADQ
Youngs Rd(SR 2026)									
Delaware-Den Rd	0.68	20	60	6500		6500	3500	ADQ	ADQ
Den Rd-STBDRY	2.23	20	60	6500	1065	6500	2700	ADQ	ADQ

APPENDIX D -- ROTARY INTERSECTIONS

A rotary intersection is one in which all traffic travels in one direction around a central island. The size of the central island depends upon the length of the required weaving sections.

They are generally cheaper to construct than a grade seperation having a full compliment of interchange ramps and bridges. Landscaping of the central island also helps control glare from the headlights of oncoming vehicles.

A rotary interchange is most likely found at an intersection where there are five or more intersecting legs and all movements, other than through traffic on the principle highway, are relatively small and can be handled on the weaving sections. Figure D-1 illustrates a five-leg rotary.

For a typical rotary to function efficiently the volume of turning traffic must approach or exceed the through volume, traffic volumes on all intersection legs must be approximately equal, and the total volume entering the intersection from all legs must be 3000 or fewer vehicles per hour and sufficiently large right-of-way must be available. When rotaries are warrented and properly designed they provide for orderly, continuous flow with little delay and a high degree of safety, which are especially suitable for intersections with five or more legs.

Rotaries allow for left turns to be performed easily by merging and diverging with one-way flow and are generally cheaper to construct than grade seperations having equivalent functions.

Unfortunately, rotaries have no more capacity than a properly designed and controlled grade crossing and are generally more costly than a similar grade crossing. Their continuous flow operation does not permit traffic control for pedestrian safety. Extremely large central islands or excessively low operation speeds are required when weaving volumes exceed 1500 vehicles per hour regardless of the number of lanes. Large central islands increase travel times and operating costs.

Rotaries are not readily adaptable to stage development because a grade seperated rotary is usually overdesigned.

Transporation and Traffic Engineering Handbook, ITE, 1976

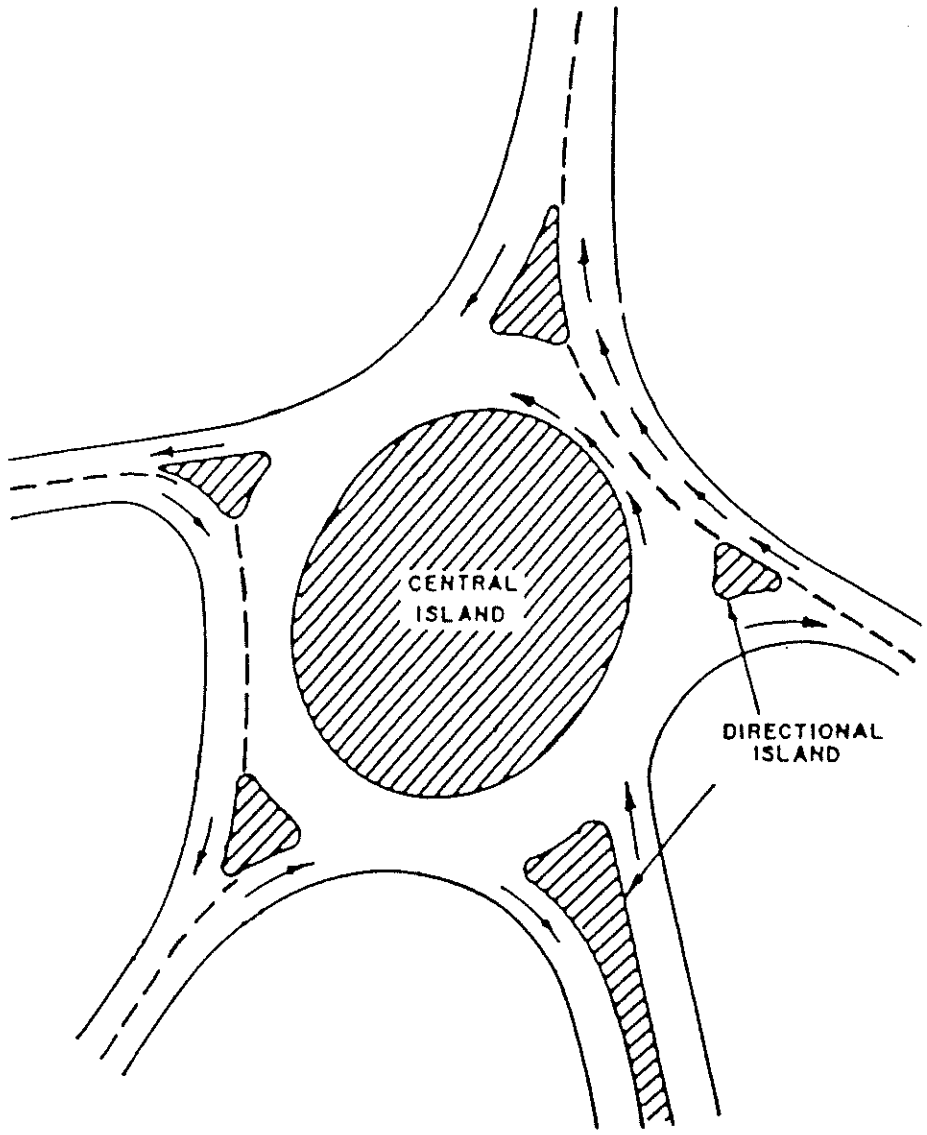
Transportation Engineering Planning and Design, Paquette, Ashford, Wright, 1962

A Policy on Design of Urban Highways and Arterial Streets
AASHTO, 1965

A Policy on Design of Urban Highways and Arterial Streets
AASHTO, 1973

Traffic Engineering Handbook, ITE, 1965

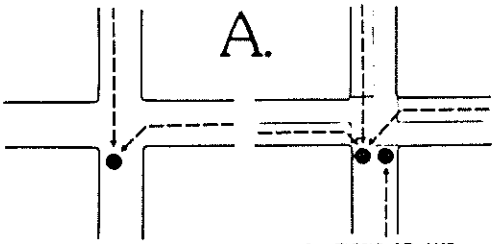
FIGURE D-1



APPENDIX E
ONE-WAY STREETS

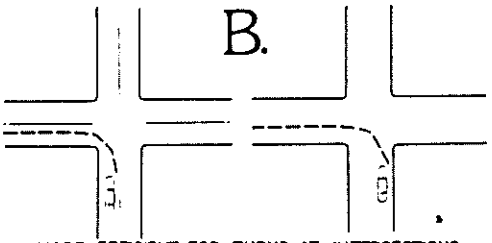
I ADVANTAGES OF THE ONE-WAY SYSTEM

A.



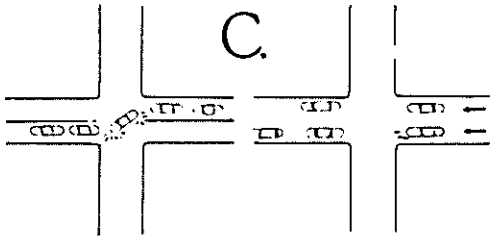
REDUCTION IN THE NUMBER OF VEHICULAR AND PEDESTRIAN CONFLICTS.

B.



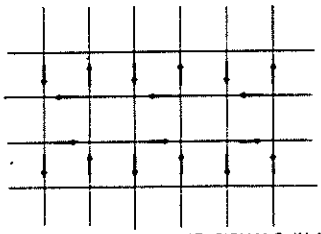
MORE EFFICIENT FOR TURNS AT INTERSECTIONS.

C.



HIGHER LANE CAPACITY

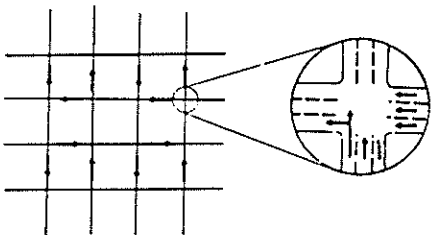
D.



EASIER TO COORDINATE SIGNALS IN A ONE-WAY SYSTEM

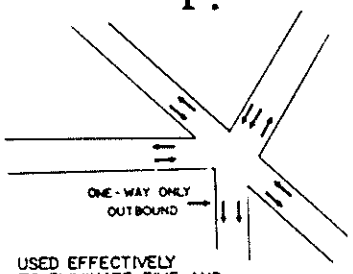
FOR A CONTINUOUS STREET, TRAFFIC SIGNAL COORDINATION IS IMPROVED GREATLY. FOR THE ENTIRE BLOCK SYSTEM IN THE CENTRAL AREA, IF BLOCK SPACING IS REASONABLY UNIFORM, IT IS POSSIBLE TO COORDINATE FOR ALL MOVEMENTS.

E.



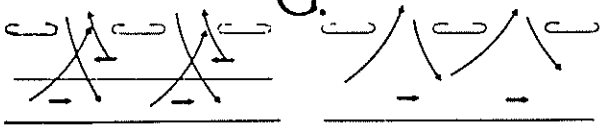
HANDLES HEAVY LEFT TURNING MOVEMENTS

F.



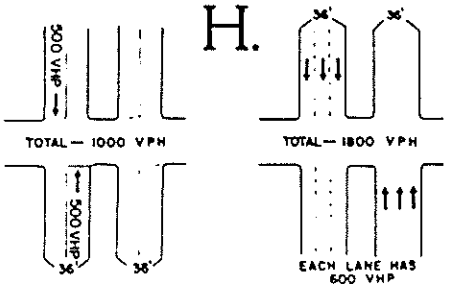
USED EFFECTIVELY TO ELIMINATE FIVE AND SIX SIDED INTERSECTIONS.

G.



LESS FRICTION FROM OFF-STREET PARKING AREAS, SERVICE STATIONS, EMERGENCY VEHICLES, ETC.

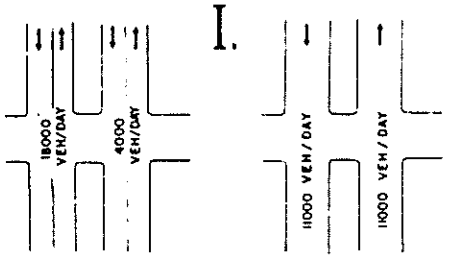
H.



INCREASES THE CAPACITY OF THE TRAFFIC SYSTEM WHERE STREET WIDTHS GIVE AN ODD NUMBER OF LANES.

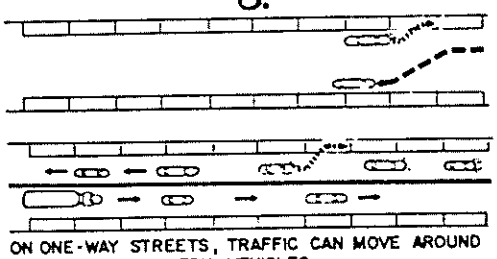
IN GENERAL, NARROWER LANES CAN BE USED A 10 FOOT LANE ON A ONE-WAY STREET WILL HAVE AS MUCH CAPACITY AS 11 OR 12 FOOT LANES ON TWO-WAY STREETS.

I.



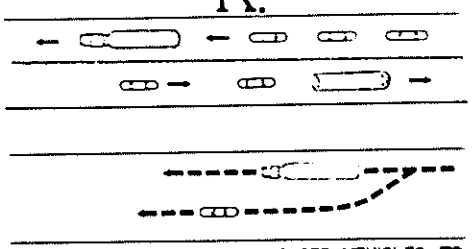
USED TO BALANCE THE TRAFFIC LOAD ON MAJOR RADIAL OR CROSSTOWN STREETS.

J.



ON ONE-WAY STREETS, TRAFFIC CAN MOVE AROUND PARKING OR DELIVERY VEHICLES.

K.

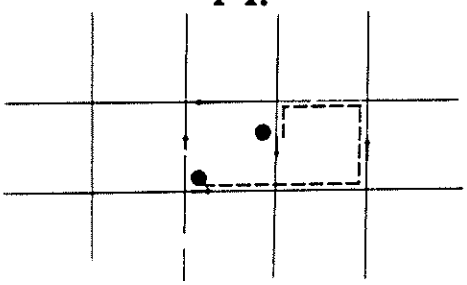


ONE-WAY PAIRS PERMIT PASSENGER VEHICLES TO PASS COMMERCIAL VEHICLES.

APPENDIX E (CONTINUED)

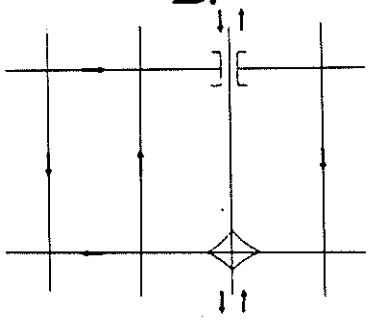
II. DISADVANTAGES OF THE ONE-WAY SYSTEM

A.



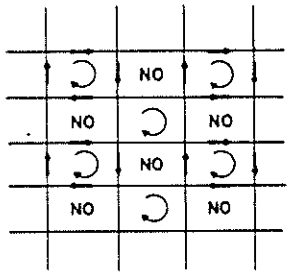
CERTAIN TRIPS MAY BE MADE LONGER BECAUSE OF THE ORIENTATION OF THE ONE-WAY STREETS.

B.



ONE-WAY STREET SYSTEMS, IF USED IMPROPERLY, CAN BE VERY CONFUSING TO THE DRIVING PUBLIC.

C.

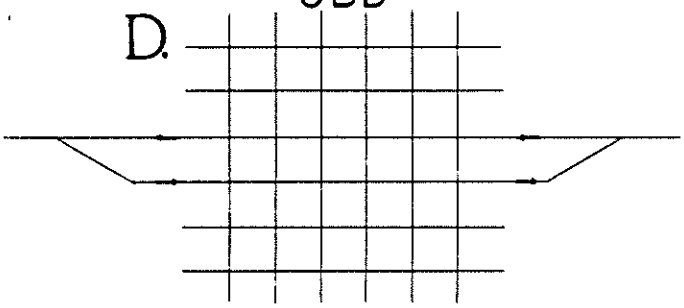


MAY HAVE A DETRIMENTAL EFFECT ON SOME BUSINESS AREAS OR LAND USES.

III. SPECIFIC USES OF THE ONE-WAY SYSTEM

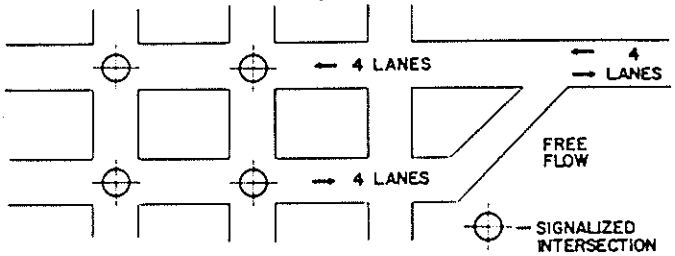
CBD

D.



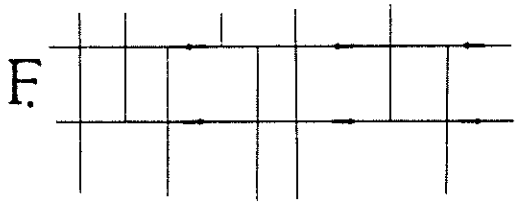
TO OBTAIN MORE CAPACITY FOR MAJOR RADIAL STREETS MOVING TO THE BUSINESS AREA.

E.



TO EQUALIZE CAPACITY IN THE CENTRAL AREA AT THE TERMINAL OF A FREE FLOWING RADIAL.

F.

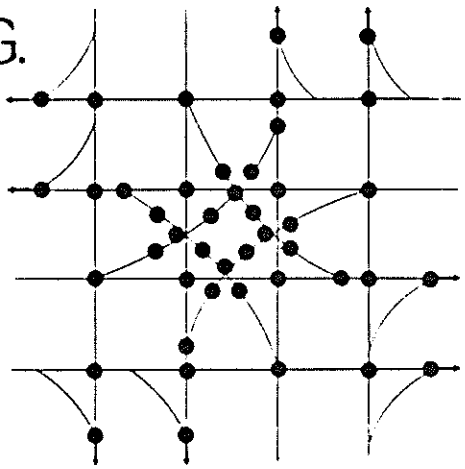


FOR CENTRAL AREAS WITH A LARGE NUMBER OF OFFSET INTERSECTIONS. (TO IMPROVE SIGNAL OPERATION AND REDUCE TURNING-CONFLICTS)

IV. SAFETY

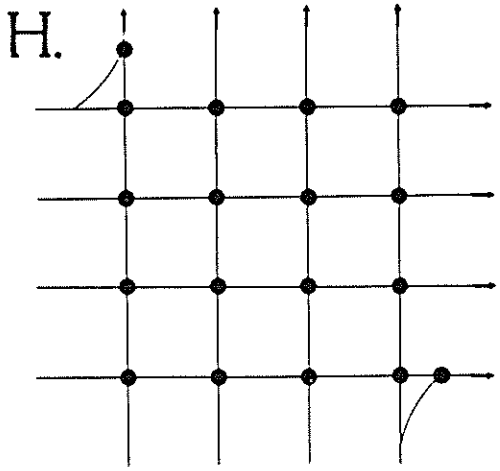
ACCIDENT FREQUENCY WILL BE REDUCED WITH A PROPERLY ENGINEERED ONE-WAY SYSTEM.

G.



TWO-WAY — 44 POSSIBLE CONFLICTS

H.



ONE-WAY — 18 POSSIBLE CONFLICTS